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THE CONDOR

VOLUME 61 JULY-AUGUST, 1959 NUMBER 4

NUMBERS, BREEDING SCHEDULE, AND TERRITORIALITY IN PECTORAL SANDPIPERS OF NORTHERN ALASKA

By FRANK A. PITELKA

When the spring snows on the tundra of northern Alaska recede in late May and early June, there is a floodtide of birds arriving to begin breeding activities in the short summer. The compression and even elimination of certain pre- and post-breeding stages in the schedule of events on the tundra and the synchrony of breeding effort in common species raise a number of questions regarding populational adaptations among birds of tundra ecosystems. For example, some species, or at least some of their members, appear to arrive paired. Another example is the shortness of the period of territorial behavior, which in some species may be compressed to the extent that observations in late June or later lead late-arriving observers to maintain that these species are non-territorial.

With such considerations in mind, several important questions can be posed for studies of arctic birds: What are the densities and spacing characteristics of common species? How does this spacing develop and change in time? And how does this timing relate to other events of the breeding and post-breeding seasons when the birds are still being supported by the tundra?

A striking feature of tundra communities is the number of shorebird species. They are wholly or primarily insect predators. Differences from year to year in relative abundance and amount of breeding in parts of the arctic, even in species considered in general to be common there, suggest a wide range of adjustment to a wide range of variation in the conditions of existence provided by the tundra. Because shorebirds collectively are such a conspicuous component of animal life of tundra, and because their general role in food chains is similar from species to species, information about them is basic to broader inquiries into the dynamics of tundra ecosystems. Comparative data on such characteristics as spacing and timing of breeding events is therefore needed if their role in food relations is to be analyzed and understood.

The shorebird fauna resident over the lower foothills and coastal plain of northern Alaska consists of 13 species: three plovers, a turnstone, seven sandpipers (including dowitcher and snipe) and two phalaropes. With these my colleagues and I have had sufficient experience over seven seasons of field work to regard them as regular breeders, however varying their numbers. These species are more generally distributed and common than was evident to Bailey (1948) from the specimens he examined from the area. An additional five species (four sandpipers and a godwit) also occur as breeders, but only locally or sporadically, and apparently rarely or never, so far as known now, in the numbers in which the first 13 can be found.

On the coastal flats near Barrow, seven of these thirteen are common: Pectoral Sandpiper (*"Erolia" melanotos*), Baird Sandpiper (*Erolia bairdii*), Red-backed Sandpiper (*Erolia alpina*), Semipalmated Sandpiper (*Ereunetes pusillus*), Golden Plover (*Pluvialis dominica*), Ruddy Turnstone (*Arenaria interpres*), and Red Phalarope (*Phalaropus fulicarius*). All but the phalarope are territorial in the classical sense, showing characteristics of advertisement, intolerance, isolation and area-attachment. Among the territorial ones, however, there is a dichotomy with regard to persistence of

the pair-bond. The members of the pair tend to remain together through the nesting season in all but the Pectoral Sandpiper. In this species, once nesting is underway, the males leave. A similar event occurs in the Red Phalarope, except that it is the females that leave. In both species the main exodus comes in the first two weeks of July. This means that a substantial fraction of the total insect predator fauna removes itself, as it were, from the scene of its replacement efforts once that replacement is started. In the Pectoral Sandpiper, males presumably move to more southern latitudes, at least into Canada and the United States, to spend the rest of the summer before migrating to their South American wintering grounds, but this interesting matter has never received any systematic study.

It is the objective of this paper to report on several population characteristics of one of the common northern Alaskan shorebirds, the Pectoral Sandpiper, and to suggest a framework within which comparisons with other shorebird species may be sought in the interests of a clear and generalized picture of their breeding ecology.

Finally, a side issue regarding the Pectoral Sandpiper needs mention in the introduction. The reader has noticed that I put its generic name in quotation marks. I have no definite views of the limits of the genus *Erolia* for lack of knowledge regarding most of its members; but it seems doubtful that *melanotos* is close to its typical members, if these are exemplified by *bairdii* and *alpina,* the two other species of the group which I know best. Europeans (British Ornithologists' Union, 1952) place the Pectoral Sandpiper in the more inclusive genus *Calidris,* which consists of *Erolia* and *Ereunetes* of the A.O.U. Check-list (1957) along with the two species of knots. My acquaintance with northern Alaskan shorebirds and their behavior has to do with six members of this complex (actually seven since "*Crocethia*" appears to be merely an *Erolia* like *bairdii* and *alpina*), and although my experience with them was acquired mainly "on the run" with other work, I would suggest that *melanotos* is not closely related to any of these seven except possibly *fuscicollis* (see discussion). Perhaps the relationships of *melanotos* within *Erolia* can be elucidated only when more information is available for Eurasian as well as American members of the eroliine complex. More studies such as the recent ones of Portenko (1957) and Gladkov (1957) are needed. One characteristic already mentioned in which *melanotos* differs from most members of *Erolia* is in the brief duration of the pair-bond. Other equally or more basic differences will be brought out in the sections to follow. It may seem far-fetched now, but I suspect that *melanotos* is relatable to *Philomachus,* the Ruff of Eurasia.

DEDICATION

It is a pleasure to dedicate this paper to Erwin Stresemann on the occasion of his 70th birthday.

ACKNOWLEDGMENTS

This paper is based on research conducted from the Arctic Research Laboratory, Barrow, Alaska, from 1951 to 1953 and 1955 to 1958 with support from the Arctic Institute of North America and the Office of Naval Research. Reproduction in whole or part is permitted for any purpose of the United States Government. For facilities provided at the Arctic Research Laboratory, for generous assistance in many ways, and for friendly counsel, I am indebted to Ira L. Wiggins and G. Dallas Hanna, past directors, and to Max C. Brewer, present director.

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For translation of a Russian reference, I express my thanks to Gordon H. Orians. Madame E. Kozlowa of the Zoological Institute, Leningrad, has kindly called my attention to several recent papers dealing with Eurasian species of shorebirds. Paul D. Hurd, Department of Entomology, University of California at Berkeley, identified insects from stomach contents. For comments or information helpful in the preparation of this paper, I am also indebted to P. H. Baldwin, T. J. Cade, A. H. Lachenbruch, W. J. Maher, P. A. Marler, G. H. Orians, and especially to W. J. Hamilton III, whose recent paper on the Pectoral Sandpiper (1959) was the impetus for the preparation of this one. Gene M. Christman made helpful suggestions regarding the illustrations and prepared the final versions.

METHODS

Field work in northern Alaska was conducted in five seasons, 1951 to 1953 and 1955 to 1956 and was based at the Arctic Research Laboratory near Barrow. My own records are supplemented by those of other observers also working at Barrow in the same years and in 1957 and 1958. Their names are given in the acknowledgments.

Observations of significance on local movement, habitat use, nesting, and behavior were routinely recorded in field notebooks through each summer. The bulk of the data for this paper, however, is taken from breeding-bird censuses of three plots mentioned by Pitelka, Tomich, and Treichel (1955:87). Their location with reference to Barrow is shown in figure 1 of that paper. The number of censuses for each plot and the inclusive dates are as follows:

	Plot 1 Old beach ridge 40 acres	Plot 2 Low tundra 20 acres	Plot 3 Marsh flat 86 acres
1951	8 (4), June 10–July 15	9, June 13–July 17	3, June 27–July 16
1952	10 (2), June 11–July 12	8, June 13–July 12	6, June 26–July 17
1953	10, June 5–July 8	12, June 18–July 29	5, June 19–July 26
1955	5 (1), June 10–July 12		
1956	6 (2), June 5–July 14		

The figures in parentheses under plot 1 are additional censuses of the northern half only.

On plot 1, all censuses were obtained by the writer; on plot 2 censuses were obtained by others named in the acknowledgments assisted or replaced by the writer at various times; on plot 3 the writer participated in all censuses except several of those for 1952.

On the flat grassy tundra of the Barrow region censusing is easy. Vision is unimpeded, and there as in other parts of the arctic, birds are relatively unwary. Those tending to wariness, that take flight or walk away, can be seen easily because of low ground cover and low relief. Display and nesting activities occur among virtually *all* members of the resident avifauna over a four-week period, June 5 to July 5, so that with five to ten coverages of each area within this interval, the level of accuracy in estimating numbers is high.

The estimate of breeding density in the Pectoral Sandpiper is based mainly on territorial males which occupy sites over a period of days or weeks. No claim is made for the identity of an individual occurring on a given site. Presence is noted and evidence of local residency is shown by displays, territorial chasing and fighting, and association with a female at least during part of the period of territorial occupation. From a compilation of such records on a summary map, certain characteristics

of spacing can be documented and estimates of density made. This method is in general use in population studies of birds and is discussed further by Kendeigh (1944) and Pitelka (1951).

With each census, the incidence of certain activities was routinely noted on the plot map when the record of occurrence was entered. Thus, the collective censuses provide a sampling of the incidence of these several activities, and trends of change in the relative levels of each through the breeding season can be described. This will be done for incidence of pairs, territorial occupation, display flights, and flocking of the Pectoral Sandpiper.

All records of these activities were pulled from the five seasons' census data and plotted by five-day intervals. The number of censuses in each five-day interval had to be adjusted for differences in areas of the three census plots. This adjustment is based on the fact that plot 2 is twice the size of plot 1, and plot 3 is, for practical purposes, four times the size of plot 1. Thus, the adjusted values represent the number of times that 20-acre units were censused in each interval. The distribution of all censuses in five-day intervals and the values resulting from adjustment for area are as follows:

	Number of censuses	Adjusted values
June 1– 5	2	3
6–10	4	5
11–15	15	22
16–20	16	23
21–25	10	15
26–30	16	34
July 1– 5	11	25
6–10	5	10
11–15	8	18
16–20	4	5
21–25	0	
26–30	2	5

The figures in the second column represent time-area units. By taking the raw frequencies for any activity, dividing by corresponding time-area factors and multiplying by 100 to avoid fractions, we get a series of index values which describe the general trend of change in incidence of that activity through the breeding season.

The validity of this procedure rests on several considerations: The special activity was noted at the time a sandpiper's occurrence was recorded. The same procedures and same areas were used in the five seasons, with the exception that plots 2 and 3 were not censused in 1955 and 1956. This merely means that the sampling of the incidence of the several activities is more limited for those two seasons than for the previous three. As the purpose of this analysis is to provide a generalized schedule of breeding-season events, this difference in sampling is not serious. Ease of censusing on flat tundra with low cover has already been mentioned. Censuses were carried out during either morning or afternoon hours, and timing varied for each plot. However, this is not considered to produce bias because the daily activity period of birds in general under circumstances of continuous light at 71° 20′ N latitude is not only long but, in the Barrow region, modified frequently by changing weather so that no consistent difference in censusing conditions was necessarily to be expected between morning and afternoon hours even if one part of the day were favored. Censusing was deferred on occasion if the weather was so bad that efficiency was seriously reduced. Nevertheless, in the interests of regularity and comprehensiveness, censusing occurred under widely varying weather conditions. Thus, while censuses were taken in that part of the daily cycle when the majority of birds were active, in other respects the procedure was about as unbiased as circumstances would permit.

Local habitat differences do not appear to complicate the arguments for the procedure described above. In common species occurring with fair consistency over the mosaic of tundra habitats, there may be local variation in abundance level according to prevalence of upland versus wet marsh. In the Pectoral Sandpiper, territorial males favor upland sites; transient flocks tend to occur more frequently in low or wet tundra. As the range of habitats on the three plots collectively is typical of the area, and as no one activity is limited to a particular habitat type, it is considered that the

sampling of activities is adequately representative for purposes of a general picture. The fact is that year-to-year differences in relative abundance of the Pectoral Sandpiper and several other species are greater than local differences related to habitat observed in any *one* season.

The distribution of sampling effort is good for the main part of the breeding period, June 11 to July 15. While the sampling from June 1 to 10 should have been better, the main activity on a population scale occurs after June 10 anyway, and the limited data for early June are considered to reflect adequately the general trend of events.

It may be added that although much is made here of data from census plots, these are subject to evaluation on the basis of additional field experience with Pectoral Sandpipers away from the census plots in each season. Moreover, the notes of all coworkers give information which supplements and to some extent tests that of the censuses. This information was gathered as events in the field having to do with Pectoral Sandpipers struck the observers as worthy of record and as time permitted such recording, for this species was never a special subject for our research. What we have outside of census data is as much a credit to the Pectoral Sandpipers' colorful extrovertedness as to any other circumstance. Only the Red Phalarope is comparably intriguing among breeding shorebirds of the Barrow area.

Date for breeding season were obtained from egg dates in several collections mentioned in the acknowledgments and from records obtained by my coworkers and myself. The large sample in collections for this arctic locality is mainly the result of extensive collecting in the 20's and 30's by Charles D. Brower and more recently by his sons (Bailey, 1948:40). Data on young were obtained by us in the field with the exception of three dates for downy young in museum collections from the Barrow area.

DISTRIBUTION ON THE ARCTIC SLOPE

The Pectoral Sandpiper occurs generally over the arctic slope from the foothills to the coast. How far inland and upward it occurs is not known, but it is present commonly at Umiat, at 300 to 400 feet elevation (Kessel and Cade, 1958:52) and also at East Oumalik, 280 feet (Childs, MS). It has also been recorded at the mouths of the Nuka and Etivluk rivers (Kessel and Cade, *loc. cit.*), both tributaries of the upper Colville at elevations of 1800 and 1200 feet, respectively. The species breeds along the lower Etivluk and probably also along the Nuka and other parts of the upper Colville drainage. Localities mentioned here and elsewhere in the text are shown in figure 1.

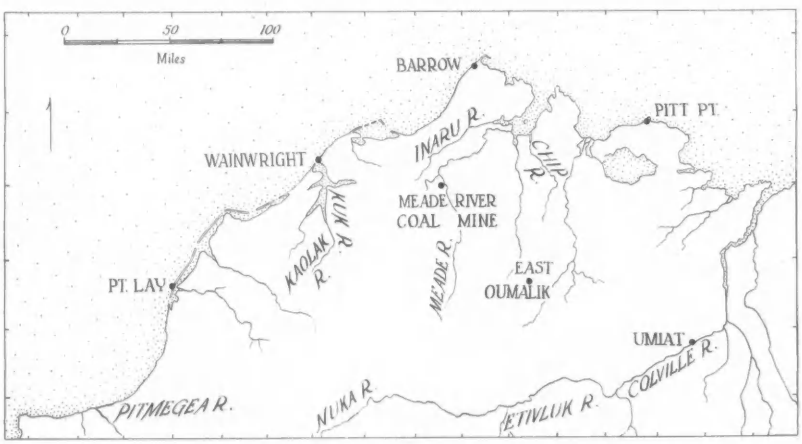

Fig. 1. Map of northern Alaska showing localities mentioned in the text.

Near Barrow, Pectoral Sandpipers usually appear in the first week of June. Our records are as follows:

Year	First day of field work	Earliest record
1951	June 7	June 7
1952	May 29	June 9
1953	May 27	June 1
1955	May 29	June 6
1956	May 29	June 6
1957	May 30	June 1

The late date for 1952 is explained by persistence of late snows which delayed arrival and onset of breeding in several species. Given a mild spring and early exposure of the tundra, Pectoral Sandpipers may appear several days ahead of our earliest record. In 1898, Pectoral Sandpipers were taken at Barrow on May 30 (Stone, 1900:26). In 1914, at Demarcation Point, to the east of Barrow and close to the Yukon border, Brooks (1915:384) recorded first arrivals on May 23, some of which were said to be associating in pairs. In 1949, at Wainwright, Rausch collected two males on May 25 and 26, respectively. In 1957, along the Meade River 60 miles south of Barrow, a male already displaying was observed on May 31 (Maher).

Nesting begins in the second week of June and continues for one month, with some nestings initiated as late as the second week of July. Small partly grown young may be seen from the second week of July through the second week of August. In the interior, and to the southwest toward Cape Lisburne, this schedule is shifted forward somewhat (see fig. 3). Flocking occurs most conspicuously (pertaining to both numbers and frequency in the last week of June and in the first half of July; it occurs irregularly until the third week of August, after which only straggling small flocks are seen. The latest dates of occurrence recorded by us are September 1 at Barrow and September 3 at Meade River.

Field experience over a series of years leads both T. J. Cade and me to regard the Pectoral Sandpiper as the most generally distributed and probably the most abundant sandpiper on the arctic slope of Alaska. In many places it is or can be, depending on the year, the commonest species.

Large year-to-year differences in relative abundance may occur. Near Barrow, for example, the species bred abundantly in 1953; but it did so sparsely and was scarce after mid-July in 1952, and apparently also in 1958 (Cade). In the interior, such variation appears to be of a lesser order, and at Umiat the Pectoral Sandpiper is common and quite consistently so. Thus, in five out of seven seasons between 1949 and 1958, it was regarded as the commonest species (Kessel and Cade, 1958; also our records). In 1957, early in the breeding season, the Pectoral Sandpiper was considered the commonest shorebird species at Meade River Coal Mine (Maher) and near the Inaru River (Cade); similarly it was the most abundant species later in June at Wainwright in 1955 (Childs) and 1958 (Brock). It was noted as one of the commonest shorebirds at Point Lay and Pitt Point in 1957 (Cade), and along the Pitmegea River in 1958 (Childs), even in mid- and late July, after males had left; at both localities frequent calling and distraction displays of females indicated presence of young scattered over the tundra.

The Pectoral Sandpiper is the commonest species in many places even though some smaller species of sandpipers associated with it, such as the Red-backed and Semipalmated, are also widely distributed and regardable as common, at least near the coast. These latter species occur more scatteredly, in pairs tending to remain intact through the breeding season, and they apparently hold territories larger than those of the Pectoral.

HABITAT

The Pectoral Sandpiper, like most bird species which breed on the coastal plain, is active over a variety of tundra habitats which are intermixed in mosaic fashion over a terrain that is flat, poorly drained, and usually wet. Near Barrow, several variants of low grass-sedge cover prevail over these habitats (Britton, 1958), and near Umiat the main habitats are grass-sedge marsh of a type similar to one at Barrow but with lusher, taller growth, and cottongrass tussock-dwarf shrub tundra of a type which becomes important about 30 miles south of Barrow. On both of these areas, shores of lakes and ponds are also visited, especially when these are on or adjacent to areas of the types just mentioned, where territorial and breeding activities take place.

Near Barrow, territorial males settle on low, flat wet marsh if there is available some promontory or raised area such as a mound, hummock, or low shelf. They settle more frequently on higher ground with a more varying microtopography as along low ridges separating marsh flats or on uplands with ponds and marshy basins of varying size. It appears that in choice of nesting area, females are not attracted to high ground, and nesting near Barrow occurs in all variants of tundra vegetation as long as there is a continuous cover of grass or sedge and the nest site is a relatively well-drained one.

This implies that members of a pair do not associate through the nesting period. Many aspects of the pair relationship in Pectoral Sandpipers require study, but there are several lines of circumstantial evidence indicating that the relationship is brief. Thus, a female with clutch completed does not associate closely with a male. Males do not share in incubation, and they leave the breeding grounds before most eggs are hatched. Females establishing nests evidently avoid the areas heavily utilized by territorial males, for, as data in ensuing sections will show, the number of females nesting on or near plot 1 was only a small fraction of the number of females observed associating with males settled on that plot. Consequently, there is reason to believe that in habitat distribution, nesting females are more widely dispersed than are territorial males. Over the five breeding seasons for which census data are shown in figure 2, there are but five instances of females nesting in the vicinity of male territorial sites; these are marked by + signs. In each instance both male and female were noted near such sites only on the last date given for the male; but in each the female remained present through the first half of July. It may be significant that these nestings near or within male territories are all relatively late.

BREEDING DENSITIES NEAR BARROW

Breeding densities of territorial males on plot 1 are shown in figure 2. This plot, 20 x 2 acres, was located along a low ridge separating extensive marshy tundra and clusters of small ponds and polygons on either side. With relatively high ground continuing along the axis of plot 1, this area provided optimal habitat for territorial males. Densities of established males in the five seasons along with numbers of nesting females remaining on their respective areas after local males left are as follows:

	1951	1952	1953	1955	1956
Males					
Two or more records	6	2	8	4	3 (4?)
One record only	1	3	4	1	2 (0?)
Females	0	0	3	2 (3?)	0

Thus, using records for territories found held on at least two dates, densities ranged from two to eight males over the plot of 40 acres; if we add single records to these, the densities ranged from 5 to 12.

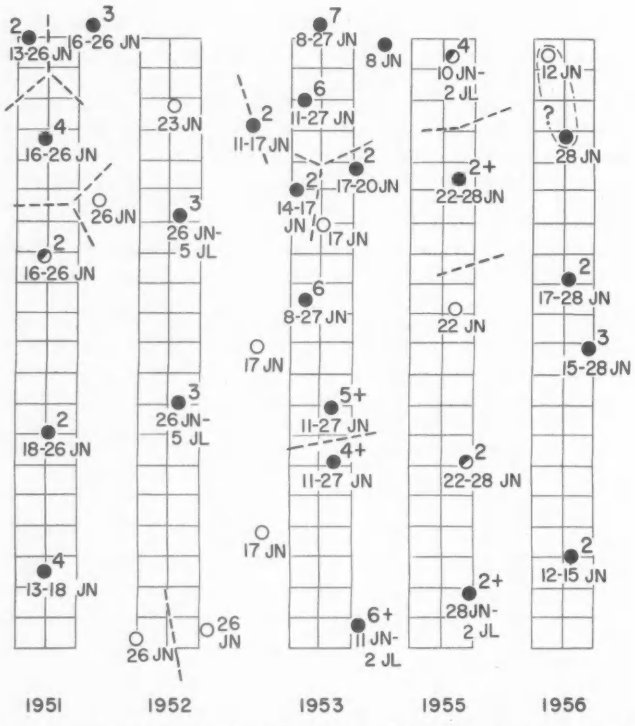

Fig. 2. Occurrence of established breeding male Pectoral Sandpipers in five summers on a census plot of 40 acres (plot 1 of text) near Barrow, Alaska. On each 20 × 2-acre grid, circular symbols indicate location of settled males: a solid dot indicates a male observed associated with a female at least once; half-shaded circle, a male seen near a female at least once, but association not close and leaving doubt; open circle, male not observed with a female at any time. The interval over which a territorial site was found occupied is given below each symbol, and the number of records (separate dates) on which a male was present is given to the upper right of each symbol. A + sign indicates territorial sites near which nesting females were present in late June and July. Broken lines indicate territorial boundaries between neighboring males.

These figures, however, must be lowered to get closer to true density because they include individuals whose territories were only partly contained within plot 1. From the spacing of males shown in figure 2, and taking into account evidence on territorial chases and evidence for boundaries on all plots censused, territory size is estimated to be from 10 to 15 acres. In 1953, in the densest population recorded, territories averaged smaller, some being no more than 6 to 8 acres. In that year, more use was made of the lower portions of the gentle slopes bordering plot 1 along its long axis; more males were also established on the neighboring low wet marsh of plot 3 (see beyond).

On plot 2, although the habitat averaged lower and wetter, the overall mosaic included islands of high ground, and breeding densities did not differ significantly from plot 1. On plot 3, however, breeding densities were lower because of the extensive flats of

low marsh. Nevertheless, these additional plots reflected the differences between 1951, 1952, and 1953 found on plot 1, as the following tabulation of occupied territories shows:

	1951	1952	1953
Plot 3 (86 acres)	2 (4?)	0 (2?)	7
Plot 2 (20 acres)	2 (3?)	2	4
Plot 1 (40 acres)	6 (7?)	2 (5?)	8 (12?)
Totals	10	4	19

From these data, maximal densities on varied tundra providing sufficient islands of relatively high ground may be estimated at 10 to 15 breeding males per 100 acres. The lowest density observed, in 1952, was three per 100 acres. Five or six per 100 acres is probably more usual or "average."

The figures indicate number of territories of which at least parts were included with the area of the given plot, and those in parentheses give the number of territories if we include birds recorded in territorial display and/or paired and apparently attached to an area on but one date. The totals indicate better the magnitude of differences in local breeding numbers among the three years than do the data for plot 1 alone. This difference is three- to five-fold depending on whether or not one takes into account the maxima indicated in the parentheses.

BREEDING SEASON

A total of 76 egg dates is available for the Barrow area (fig. 3). Included are a few from localities along the coast to the east as far as the Colville River. An additional 29 are available for inland localities to the south and southeast of Barrow, along the Meade and Chipp rivers (fig. 3). These localities are 60 miles south to 75 miles southeast of Barrow, within the belt of the first low hills in the direction of the Brooks Range.

The distribution of dates for complete clutches shown in figure 3 are based on dates on which the clutches were taken; that is, no adjustment has been made to bring them forward within some modal interval assumed to represent the main period of laying. Nevertheless it appears that near Barrow most clutches are laid in the interval from June 21 to 30. All known clutches consisted of four eggs. The incubation period is at least 23 days (Conover, 1926:308), and the period when most young are seen near Barrow is from July 16 to 25. When allowance is made for a few days spent in or near the nest by young just hatched or hatching, the interval between modal periods of egg laying and of young recently hatched but already moving over the tundra freely is about right.

Clutches can be started as late as July 8. Thus, Bee (1958:187) reports taking a female on July 9, 1952, which had an egg in its oviduct plus two enlarged ova with diameters of 20 and 10 mm. probably representing the third and fourth eggs of a clutch. One complete set obtained along the Chipp River on July 15, 1933, was labelled "eggs fresh"; another, "perfectly fresh," was taken at Barrow on July 6, 1883 (Murdoch, 1885:112).

Prior to June 15, near Barrow, the incidence of first eggs is probably low. Most of the dates in figure 3 are based on sets taken in the years from 1926 to 1938, and of the eight sets taken prior to June 21, all but three of those in the interval 16 to 20 were obtained near Barrow in one season, 1938. Early records for 1938 suggest that the summer might have started especially warm that year, but temperature records of the Weather Bureau for Barrow do not bear this out.

There is other evidence to support the statement just made regarding infrequency of clutches started prior to the 15th. Murdoch and his coworkers (1885) obtained 18

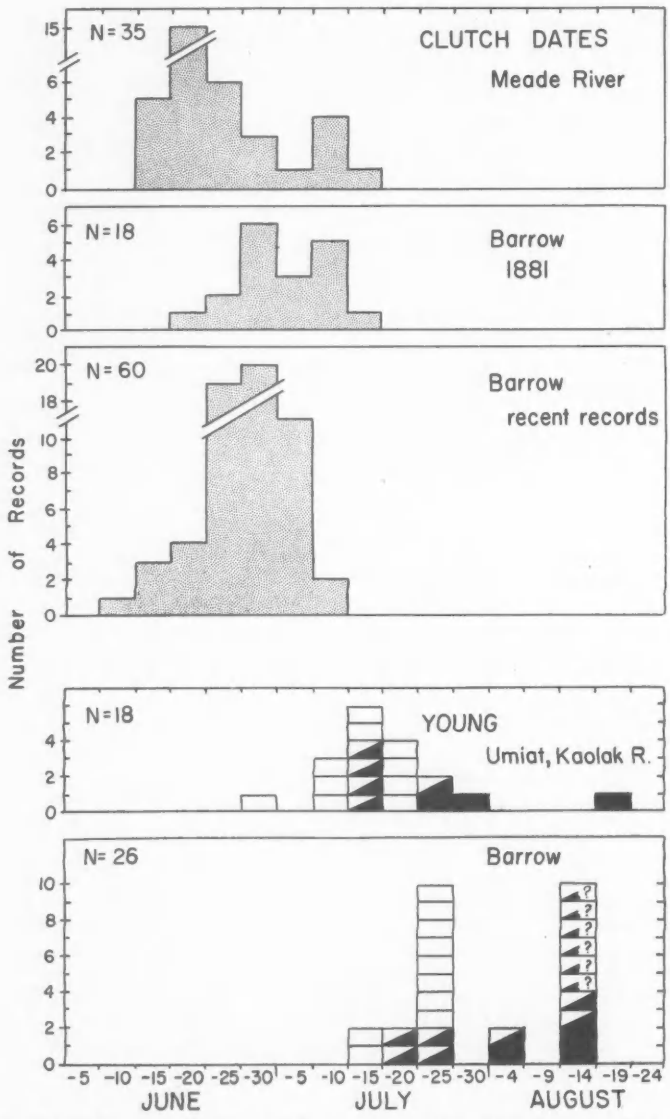

Fig. 3. Breeding season of the Pectoral Sandpiper in northern Alaska shown by distribution of dates for clutches of eggs and for young observed or collected. Dates are grouped in five-day intervals: June 1–5, 6–10, etc. Open blocks indicate young recently hatched; partly shaded blocks, partly grown young; solid blocks, young fully grown or almost so. For recently hatched young, each record represents one individual or, if two or more siblings were observed, one family group. (The year "1881" should read 1883.)

clutches in 1883, a sample from one season and one locality now in the United States National Museum and not bettered as a single-season sample by any data I have from all the egg collecting in northern Alaska since then. The earliest collection date was June 20, although earliest actual laying on the basis of large embryos in one set taken June 28 was about June 10; the latest collection date is July 12 (*op. cit.*:112). [Murdoch (*loc. cit.*) states "most of the eggs obtained were collected in 1883," but according to records sent to me from Washington, the 18 sets discussed here were all taken in that year.]

Thus, the breeding season in 1883 (see fig. 3) was evidently somewhat delayed over the normal timing, but as ensuing sections will show, such variation is probably not unusual. Seasons in which breeding near Barrow averages earlier than shown by the distribution of recent records in figure 3 must be rare.

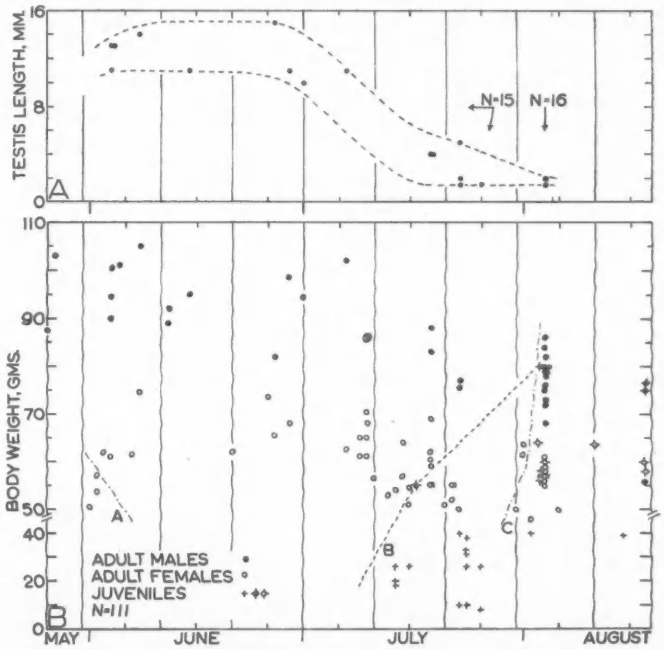

Fig. 4. A, seasonal change in testis size (length of left testis) of Pectoral Sandpipers. Measurements from the sample of 16 for early August include both adult and juvenal individuals, but none exceeded 2 mm.; all other males were known adults.

B, variation in body weight showing gradual decline for adults through the summer. One exceptionally heavy female, in egg-laying stage (July 9), shown by a double circle; all other adult females in pre- or post-laying stages. All weights taken from specimens collected on breeding grounds from foothill districts (Umiat, Kaolak River) north to coast, except three females to left of line A taken at Anaktuvak Pass (see text). Line B shows the approximate trend of appearance of earliest young at successive weight levels; hence all records of juveniles fall on this line or to the right. Line C: to the left, adults and juveniles are separated; to the right, all known juveniles (12) are indicated by symbol, but the remainder (28) includes both adults and juveniles not aged satisfactorily when collected. Note change in scale at 50 grams.

Taken in body, the data indicate that near Barrow egg laying may begin as early as June 5 or 6 (earliest completed clutch taken June 9), but that most clutches are started between the 15th and 25th of June, while latest clutches may be started as late as July 5 to 10. While known dates of laying would be required to establish the maximal interval over which clutches can be started in any one year, from the data at hand it seems reasonable to guess that this period is about 30 days.

Over this period plus a week or so in early June, males may breed, as is shown by data on seasonal change in testis size summarized in figure 4A. They arrive on the breeding grounds with testes fully developed or almost so. Testicular regression begins in early or mid-July and is completed in about a month's time, prior to or during the first laps of migratory movement.

In the interior, snow melt and onset of spring is earlier, and as a result some differences in timing of breeding occur between there and the coast. Figure 3 shows no significant difference in the total period over which clutches were found, but the modal period for egg laying in the population as a whole is evidently earlier. The median date for 29 clutches from the interior falls in the interval from June 15 to 20, whereas for the two Barrow distributions, the median dates fall in the interval from June 26 to 30. A similar difference appears in a comparison of the dates on which young have been seen or collected (fig. 3). There is thus probably as much as a week's difference in the population timing of breeding activities between the tundra bordering the arctic coast near Barrow and that 50 to 100 miles inland.

SUMMER WEIGHTS

Weights from northern Alaskan specimens are graphed against time in figure 4B. For both sexes, it appears that maximal weights occur through June and that there is a gradual decline in average weights through the summer. Females in egg-laying stage would be substantially heavier than those comprising the sample discussed here. One such female weighed 86 grams; the recorded maximum otherwise, for June females, is 75. The trend in summer weights is summarized as follows:

Sex	Time interval	Sample size	Range	Mean with standard error
Males	June	11 adults	82-105 gms.	94.6±1.9 gms.
	July	5 adults	75-102	85.0±4.9
	August 1-5	16 ads. & juvs.[1]	68-86	78.2±1.0
Females	June	8 adults	61-75	65.9±2.0
	July 1-15	14 adults	51-71	60.2±1.2
	July 15-31	13 adults	50-69	57.5±1.6
	August 1-5	13 ads. & juvs.[2]	46-64	56.7±1.3

[1] Males weighing less than 65 grams excluded; these are assumed or known to be juveniles incompletely grown, some possibly also missexed.
[2] Females as low as 46 grams included in this distribution because known adults of this sex weighed as low as 50 grams in late July.

Three low weights from females taken at Anaktuvak Pass in the first days of June and almost certainly in migration are not considered to be significant exceptions to the earlier comments about June maxima since it is likely that migrants heading for the coastal plain have ample opportunity to gain weight in the days or perhaps even weeks when they are already in Alaska, advancing northward as weather permits.

Also shown in figure 4B are weights of juveniles at various stages of growth. From these data it is seen that the main growth period for the population of young is the latter half of July and early August and that by the first of August, some young have already entered the weight ranges for the adults then present.

The data give no indication of premigratory weight gain in adults or young through late July and August. To whatever degree such gains occur, they evidently do so south of the breeding grounds. This is supported by weights of Pectoral Sandpipers collected on August 5, 1957, in southern Manitoba, at Delta (just north of 50° N lat.). All were adults.

	N	Range	Mean
Males	8	99.5–141.0	117.6 gms.
Females	3	56.0– 99.5	71.2

On the basis of July weights for males and late July weights for females given above, these southern Manitoba records yield estimates of weight gains of 38 and 24 per cent, respectively.

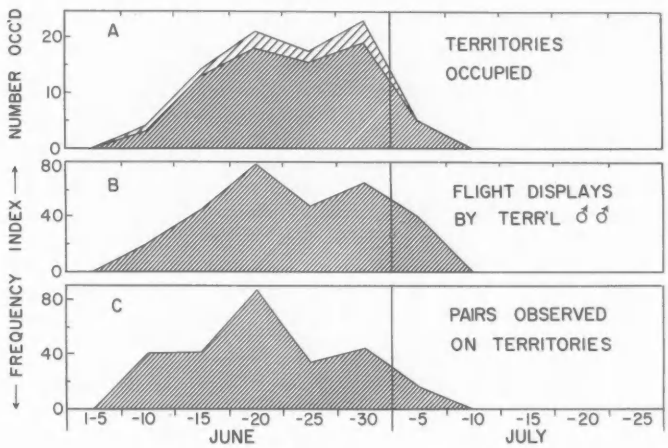

Fig. 5. Timing of certain breeding activities of the Pectoral Sandpiper near Barrow, Alaska.

A, change in number of territories occupied, based on a summing of all records from census plots for five years. Each territory or locally settled male is represented by only one entry in any five-day interval; those males or sites for which there are two or more records in a given breeding season fall within the densely barred portion of the graph, while males for which there is but one record in a given breeding season are shown by the lightly barred band.

B, change in frequency of flight displays of territorial males, based on records from census plots adjusted for varying amounts of sampling effort (see text).

C, change in incidence of pairs observed on territories occupied earlier or later (or both) by males; data obtained as for graph B.

SEASONAL TREND IN NUMBERS IN RELATION TO BREEDING SCHEDULE

Numbers increase through June, but the data (figs. 5 and 6) suggest two waves of arriving birds—not literally "waves," but rather statistical modalities in numbers recorded indicating the chief periods of change in local abundance. The bulk of the breeding population settles down in the course of the first three weeks. With the second "wave," there appears to be additional breeding effort, but it is not clear to what degree such effort is the first for the season as against renesting. To varying degree between

years, this second wave apparently also includes nonbreeders. These questions will be considered further after the normal schedule is described.

In the first weeks of June, the arriving members of the breeding population spread inconspicuously, there usually being no large flocks or local concentrations preceding dispersal for breeding such as characterize the Red Phalarope. Early arrivals may concentrate on islands of exposed tundra along the coast (Murdoch, 1885:111); but the main movement of sandpipers along the coast eastward and their spread over the tundra for breeding stations occurs by more or less continuing drift, weather permitting, of single individuals and small flocks that rarely exceed a dozen individuals, and usually number around six.

By the end of the first week of June territorial males are displaying and pairing starts. There is typically an interval of at least a few days between arrival and onset of these activities. With poor weather, only a fraction of the males display early and then relatively infrequently. With warm weather, and especially by mid-June, one gains the impression that males still on the move and encountering already settled and aggressive males are ready themselves to settle down given suitable sites. The seasonal build-up of display and pairing is shown in figure 5. On the basis of area-related samples taken in the course of five years' census work (see methods), the numbers of males settled on territories is shown to increase until the 15th, and the amount of display activity reaches a peak near the same date. This interval of maximal display correlates with both the end of the main period of territorial establishment and maximal frequency of pairs observed as such on occupied territories (fig. 5). Such pairs were also recorded in the interval from June 8 to 15, and some nests do get started in that interval in at least some years; but pairs were observed most frequently in the interval from June 16 to 20 just prior to the main period of egg laying (fig. 3). This evidence suggests arrival of females somewhat later on the average than that of males; it may be added that a few small flocks consisting only of females and evidently in transit were noted on June 9 and later over the several years. Females may, however, arrive as early as males (Stone, 1900; Brooks, 1914).

After June 15, territorially stationed males prevail over the tundra until the last days of June. The two latest records of territorial chase or conflict are June 27 and July 1. The latest record of both territorial occupation and display is July 5. Near the end of June and in the first week of July, males leave rather abruptly. Flocking of males then ensues, but without conspicuous local waves or concentration, and the bulk of them is gone by the 15th. In both 1955 and 1956, when the departure of males was particularly watched, on a population basis they were in effect gone by the 11th. Males may be present scatteredly until the first days of August; our latest specimen record of an adult male is July 22, but Bee (1958:187) took at least one near Teshekpuk Lake as late as August 3.

Thus, after July 5, the dispersed members of the breeding population consist only of incubating females, and this is a period of relative quiet. Eggs hatch mainly in the second and third weeks of July, and young are seen most frequently in the last half of July. Partly grown young may still be seen, however, in the middle of August. By the end of July local females that have earlier attended young are leaving, and most of them depart before the 10th of August. Much of this exodus, as Murdoch (1885:111) noted, occurs without flocking; they "slip quietly away." Males in transit in mid-July are joined by females whose nesting failed or was completed early so that mixed flocks may be seen then, and such flocks are most frequent in the second and third weeks of July. They usually consist of less than 20 individuals, but occasionally they reach 50.

Juveniles still on the breeding grounds in late July and August comprise at first the

bulk and later virtually the whole of such flocks as are seen. Near Barrow, these flocks occur, but only irregularly. If they are present, they remain locally only for a day or two, if that long, and in some seasons, no major movements or local concentrations are noticed at all. In part this may be because over the Barrow area, which projects northward in one sense as a broad-based peninsula, there is not the concentrating or funneling effect on birds in fall migratory passage such as occurs in the spring, and anyway, the main migratory paths may be overland, through passes of the Brooks Range, rather than coastwise. The late summer arrival, in Manitoba, of adults in late July and juveniles in late August (Hamilton, 1959) in general agrees with the chronology on the breeding grounds.

As is shown in figure 5, virtually no flocking occurs in the interval from June 21 to 25. On census plots none was recorded at any time in the five years of study, and there is but one mention otherwise of flocks in this interval in notebook records of any observer. This was a flock of seven males noted on June 25, 1955, the earliest such record. After the 25th, flocking is resumed and reaches a minor peak in the interval from July 6 to 10 which indicates the main exodus of males. There is an interval of relative quiet as nesting females are completing incubating or attending young. Flocking becomes commonplace from mid-July onward. Censusing stopped after July 20, but were data available over a period of years, the index of numbers of birds in flocks would tend to be high, but varying widely from year to year, not only in level of abundance but also as to the intervals of the last six weeks of the summer in which such flocks were witnessed.

Thus, for the effective breeders there are six populational phases: (1) the early summer rise in numbers of settled birds, preceded by only a low level of flocking (June 1-15); (2) the interval of relative stability, when territories are occupied in greatest number, pairing occurs and most nesting is started (June 15–30); (3) the desertion of territories by males when flocks may be seen which consist only or mainly of males (June 25-July 10); (4) the completion of incubation by females now alone and the care of young (chiefly July 10–31, occasional ones so occupied to a later date); (5) the departure of adult females, accompanied in varying degree by late occurring males and later by juveniles already flying (July 15-August 5); and (6) the exodus of juveniles (July 25-September 1). From dates for breeding events given in various reports from arctic Siberia, it is clear that the schedule is similar there. The only exception is that fall departure may be later. Thus, Pleske (1928:249) writes of *"Heteropygia maculata"* [=*E. melanotos*] migrating past the Kolyma delta until September 22, with some late birds seen on October 3.

Against all this 1952 stands as an exception. Snows persisted and the summer began a week to ten days late. Although the first Pectoral Sandpiper was observed on June 9 and the first display on the 12th, no locally settled male was seen on the census areas until the 23rd, and the majority arrived after that date. The amount of flocking in the interval from June 26 to 30 was of the same order as in the other four years, but in 1952 this represented the bulk of the arriving birds from which only some established breeding territories. Thus, four of the five territorial sites used in 1952 were first occupied in that interval (fig. 2). Only two of these were found occupied more than once. All records from plots 2 and 3 also fall or start in the interval from June 26 to 30 and not earlier. The overall record for the five years (fig. 5) shows that of 29 territorial sites found occupied in two or more censuses, for 80 per cent of them the occupation began before June 20. Thus, not only were breeding numbers lowest in 1952, but such breeding as occurred began late. Interference of breeding by weather is known for various arctic birds, for example in *Calidris temmincki* (Southern and Lewis, 1938).

There then ensued an amount of flocking, from July 1 to 10, which was three to six times that witnessed in the same interval in other years, and considerably more than that witnessed in any other interval within the part of the summer when censuses were taken. After the 10th, however, the bulk of the birds left, and after the 15th they were scarce. In the interval from August 11 to 15, the first recently hatched young were observed, again showing lateness in such breeding as occurred. On August 19, Pectoral Sandpipers appeared in numbers—they were recorded as "common on the tundra today"; but after that date, only scattered small flocks were seen, the last on September 1.

The large numbers in the first ten days of July greatly exceeded numbers of males

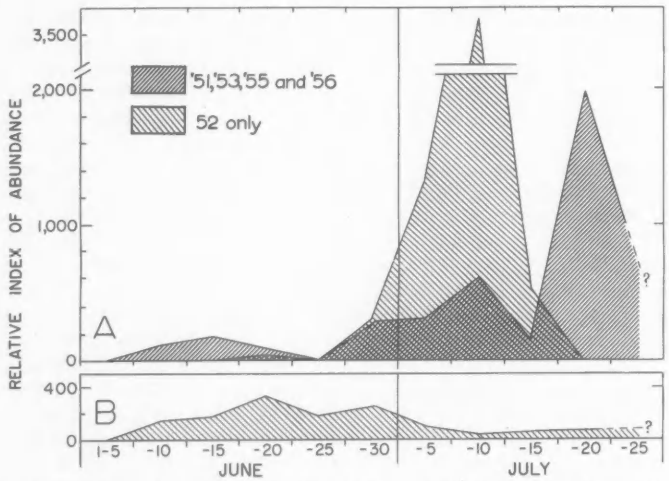

Fig. 6. A, changes in amount of flocking of Pectoral Sandpipers on their breeding grounds, based on records from census plots (see text for explanation). The usual trend is shown by the combined records for four seasons; an exceptional year (1952) is shown separately.

B, change in relative numbers of settled breeding birds, also based on records from census plots and graphed similarly so that change in proportion of settled, spaced breeders to individuals in flocks (A) may be seen.

when these desert territories in this interval in typical years, and they occurred at a time when females are attached to nests; hence, they can be considered to have consisted mainly of nonbreeders. Supporting this conclusion are the facts that the late snows delayed onset of breeding, that breeding densities over the five-year period were lowest in 1952, and that postbreeding numbers were low.

The ingress, in 1952, of large numbers in late June and early July may be an extreme manifestation of a sequence of events which occurs to lesser degrees in other years. Thus, in each of the other four years, flocking occurred in the interval from June 26 to July 10, significantly ahead of the time, even in the compressed schedule of the arctic summer, when Pectoral Sandpipers left their territories and breeding was concluded. The membership of such flocks probably includes mainly nonbreeders and others whose earlier efforts may have failed, but some at least evidently begin breeding as late as did the majority in 1952. This last point is supported by the following lines of evidence: (1) Over 50 per cent of the clutches are normally completed before June 25, an estimate

based on numbers of clutches produced by the 25th plus half of those found in the interval from June 26 to 30 (fig. 3). Yet territorial occupation continues through the last week of June without decline in anticipation, as it were, of the change to come in the first days of July. (2) Frequency of display and incidence of pairs observed on occupied territories also remained moderately high through the interval from July 1 to 5, after which neither display nor pairs were observed. The data for the trends in these several behavior patterns even show slight rises for the interval from June 26 to 30 or July 1 to 5 over the levels just preceding, individually insignificant but collectively perhaps significant. (3) The only specimen evidence lending support to this interpretation of late entrants into the breeding effort is a female collected on June 28, 1956, which lacked a brood patch and which had ova up to 8 mm.; it was probably in pre-breeding state. Murdoch reports taking "perfectly fresh eggs" on July 6. The female mentioned on page 241, taken with an egg in its oviduct on July 9, 1952, may also have been an individual which had not bred earlier.

Although no statistical significance can be attributed to the slight late upswing in breeding activities shown in figure 5 without more and better samples of such events, I do think it justifiable to say at least that the incidence of these events remained at a high enough level into the first week of July so that one concludes that some breeding is not initiated until quite late. A question remains, however, as to the degree that such late breeding effort is significant populationally or even characteristic of the Pectoral Sandpiper in general over its northern Alaskan breeding distribution. Clutch dates from the interior (fig. 3) suggest that some breeding is initiated as late as it is along the coast; but because weather usually permits the onset of breeding earlier in the interior, late breeding may not be so important on a populational scale as it is near the coast. Such importance may derive not only from wider variation in weather affecting breeding success of the population already there, but also from late arrivals which, if they settle at all and breed, probably do so more along the coast than in the interior because drifting of late birds tends to occur most in the coastal belt where seashore, deltas, lake margins and marshes provide maximal habitat for flocks.

DISPLAYS AND CALLS

In our observations of the Pectoral Sandpiper, no attempt was made in the field to study behavior *per se,* and therefore we have no record of the repertoire of display actions and the usual vocalizations accompanying any of them. We can, however, describe the commonest actions in territorial behavior forced upon our attention in the course of censusing and other field work. Several displays which figure in courtship, recorded several times by the author and his associates, are also worth describing so far as our brief notes permit. This information falls short of the standards demanded by modern ethology, but on the other hand, we do seem to have a great deal more information about the Pectoral Sandpiper on its breeding grounds than has been available heretofore. The account of displays in Witherby *et al.* (1940) and Dementiev *et al.* (1951), for example, are only approximately correct, and then only from a qualitative standpoint as they are not developed from any sustained experience with the species over a series of seasons.

Routine call-notes are described by Bent (1927:176) and Witherby *et al.* (1940: 260). We have nothing to add to these accounts with the exception of a threat note used by territorial males which is described in the section on territoriality (page 253).

Those displays recorded in our notes several times and in most instances witnessed many more are described below, but only in enough detail to show their more conspicuous features. Variants recorded as isolated instances are identified as such.

1. The most frequent display of the territorial male is given in flight on a course merely a few feet above the ground and over distances of 400 to 500 feet. The flight speed is slow, the wing beat usually shallow and broken, high over the body. There may be brief glides. The chest area is swollen so that the streaked bib stands forward of the white under parts. During flight, the male hoots regularly, two to three times per second. The note is a double *who-u, who-u, who-u,* usually given ten to twenty times in a single series, and occasionally as many as 28 (2 records). The wing beats may be deep and slow by comparison with normal flight, suggesting a butterfly. Then they are synchronized with the hoots, which are given at the slower tempo of about two per second, so that, apparently, the main hoot is given with a downstroke, the second syllable with an upstroke. With each downstroke, the head bobs up. In its strongest and loudest form, the display includes this type of wing beat. Toward the end of a display flight, the note may become just a single-syllabled hoot, and then the bobbing of the head weakens or stops. The double-parted hoot may also be given in gliding flight, or in a glide broken intermittently by quivering of wings, and here also the head will bob with the notes, but not so strongly as when the deep wing beat is used. The hoot is a low, loud, far-carrying note, although in windy weather the sound may be lost easily. The tempo is usually sustained; sometimes it increases slightly as the flight proceeds. The flight may be ended with a direct drop to the ground, or with the wings set horizontally, the bird soaring up slightly in a glide, then setting down. This display has been witnessed at Barrow as early as June 9 and as late as July 5. It is observed earlier in the interior and along the arctic coast at lower latitudes (May 31 at Meade River; May 30 at Pitmegea River). Nelson (1884) and Buturlin (1907), in describing the flight display, state that the male rises high, 30 feet above the ground or more, and hoots during a gently gliding descent. This was not the style of flight we found usual in northern Alaska.

2. A ground display in which the same note is used appears to be the usual courtship display. Typically the male is about six or eight inches behind the female and to one side of her. His chest is inflated, his wings are dropped slightly, and his tail is held vertically so that the lateral white feathers show. As he follows her, usually in short runs, less frequently at a slow sustained pace, he hoots regularly. The hoots are usually softer than those given on wing, but with chest swelled and inflated periodically as in the flight display. Instead of short runs the male may prance intermittently and even sway. In this and more terminal parts of the display (see beyond), the prance appears to be a ritualized short chase and occurs when the female is standing or when she pauses, thus frustrating the periodic advance of the male toward her. This entire performance has been likened to that of a Prairie Chicken (*Tympanuchus cupido*). Nothing like it has been witnessed in any *Erolia* or near-*Erolia* observed by us in northern Alaska.

It is stated by Nelson (1884), and this is still the latest authority for more recent statements such as those of Witherby *et al.* (1940:260), that the chest expansion is the result of inflation of the esophagus. To whatever degree esophageal inflation figures, it is not the only mechanism expanding the chest. In the breeding male, there is a striking amount of subcutaneous lobular tissue, as Nelson himself also noted, and it appears that this acts to raise the chest to varying degree by congestion with lymph or possibly even blood. Sutton (1932:135) comments on subcutaneous "glands" of *melanotos* and their occurrence also in the White-rump, *E. fuscicollis,* noting that these had a rich blood supply. Thus, in *melanotos,* the chest may remain partly "expanded" for prolonged periods of time. A male resting on a mound will appear heavy chested, the lower edge of the streaked bib will stand forth from the white of the adjacent underparts, and he will show no sign of heavy breathing nor will he be making any sounds. The morphological basis of this display should be re-examined carefully.

3. What may be a terminal phase of pairing occurs when male and female fly instead of walk, the male displaying as in 2. The male follows the female about one foot behind and to one side of her, hooting periodically. The flight continues over 100 feet or more. Both sexes beat their wings shallowly in a quiver above the level of the body.

4. In a ground display which may be merely a variant of display 2, the female, standing still, is approached by the male with his chest inflated, hooting. When a foot or so away from her, he turns to one side with the tail then raised and almost vertical and with lateral rectrices and undertail coverts showing conspicuously. He gives a cough-like note, *craw, craw, ki-li-li,* the head bobbing with the first two notes which are harsh. As the notes are given, the male runs away from the female. The latter showed no response in those displays witnessed.

A variant between displays 2 and 4 suggests that the display actions after approach by the male depend on the reaction of the female. Thus, a male approaches, as in display 4, and in addition may lower and dip the body forward slightly so that the displayed tail is the more conspicuous. The female moves away. The harsh *craw* note is then given two or three times, followed by hoots alternated with short advances toward the female. After a pause, such a sequence may be repeated. In one instance it occurred three times and a vigorous chase followed.

The *craw* note was observed on one occasion to be given three times by a male as he flew to a grassy mound and chased a male longspur from it. This suggests an aggressive component to the displays combined here under 4 as against 2, in which the action of the male is more solicitous and if any notes precede the hooting, they are weak and rather high-pitched. In the frequently windy weather of the Barrow region, soft notes are difficult to hear.

5. At the close of a display, the male may compress his plumage and raise his head and body rather abruptly becoming tall and slim. In this stance, the tail is in normal position. One record suggests a partial transition, the male slimming somewhat but still holding his tail up, prancing his feet and holding his bill open (sound, if any, not heard). In this instance the female took wing and the male followed.

6. A flight display without vocal accompaniment is given by the male when he flies low over his territory, in a straight line or in a semicircle, intermittently fluttering his wings shallowly and producing a *whirr*-ing sound. In this performance he may fly up slightly, then glide, thus following an undulating path. The few records we have of this behavior suggest that such flights alternate with hooting flights as a male crosses his territory or when he is returning to his favorite mound-post after a hooting flight. Also, it appears that this flight-glide alternation is peculiar to males on territories.

7. A raised-wing display is given by individuals on the ground, when scattered in small loose groups and not yet territorially dispersed. One or both wings may be raised in address to another individual. In a particularly strong expression of the display, both wings may be held up while the bird moves a short distance toward another individual. The records are too few and brief for comment on sexes and sizes of groups or details of actions. But it may be added that this display was observed only a few times and only in the first half of June (latest record, June 16). From comments on this type of display by Armstrong (1947) and by authors he cites, it appears that it is a mild challenge display, but it may become more vigorous, with both wings used, in aggressive supplanting as described by Hamilton (1959:167). Our observations along with those of Buturlin (1907) suggest that in *melanotos* the raised-wing display is used in the early part of the courtship period. In some shorebirds, raised-wing actions are also incorporated into ritualized displays, in pairing and mating, for example, in *Calidris*

temmincki (Southern and Lewis, 1938); but none of us has ever witnessed this in the Pectoral Sandpiper. This may perhaps be correlated in part with the circumstance of short-term pair relation in *melanotos* by comparison with species of *Erolia* in which the pair unit persists and in which raised-wing displays ("greeting signals") occur more frequently. Our finding raised-wing display rare in *melanotos* is worth special emphasis because the summary by Witherby *et al.* (1940) suggests that raised wings may figure in usual displays as they do in smaller species of *Calidris* (*Erolia* and *Ereunetes* of Americans' usage), but this does not appear to be true.

8. A strong distraction display is given by the female near a nest or near young. This has been observed many times. No such action has been seen by us in males.

TERRITORIALITY

Territoriality of the Pectoral Sandpiper is based on the male who isolates himself on an area used for pairing and probably mating and for feeding and roosting by the male and also by the female in the interval of their association. Nesting typically occurs away from male territories; if it occurs on an area used by a territorial male, the occurrence appears incidental to the presence of the territorial male somewhere in the vicinity, as the female goes about her routines alone.

Over large areas of upland tundra such as occur south of Barrow, where territorial males are established one next to the other and their hooting on quiet days in the middle of June may be heard everywhere, it seems certain the territories are self-contained except for marginal areas where local topography or positioning of water bodies buffer them so that overlap in use of feeding areas may result. But this matter requires further study, as in some situations it appears that males may feed on low marshy flats adjacent to their territories which are not included within the defended domain of any neighbor.

Densities of territorial males on census plots have already been discussed. Territory size was estimated at 10 to 15 acres; in 1953, however, with a significantly denser population, territories were smaller. Spacing of males, intervals of territorial occupation and other data from plot 1 are summarized in figure 2. Where encounters between two neighbors showed a boundary to occur, this is drawn on the map as a broken line.

Territories are held certainly over periods of days and probably even over periods of a few weeks, at least by some individuals. But the latter point requires testing with marked birds. In summarizing occupation of territories, I have done this by using the span of dates over which each area was held (see fig. 2), and deriving the total number of such records for each five-day interval.

The general timing of territorial occupation for the population as a whole along with incidence of hooting displays on territories is shown in figure 5. Territorial activity reaches a peak in the third week of June, and correlated with this is a markedly higher incidence of pairs seen on occupied territories. The data for all three series of events, in conjunction with evidence on numbers and incidence of flocks discussed, suggest a second, but weak peaking of breeding activity in the last days of June and early July as stated earlier.

Evidence from plot 1 indicates that the females in general nest in areas other than those used heavily by territorial males. Thus, presence of a female in association with a male was noted on many more territories than the numbers of females remaining on plot 1 to nest (see tabular summary, page 239). It may be that this results from the special circumstance of a continuous axial upland (beach ridge) providing particularly choice sites for territories; that is, where the mosaic of tundra habitats provides a better interspersion of the main types, males may be more widely spaced and the females occur among them more frequently. Further aspects of the pair relationship

will be discussed later. It may added here, however, that at no time was any territorial aggression, even suggestively such, observed in females.

On their territories, males announce by flight displays, challenge neighbors and intruders with such displays, repulse intruders by chase, and maintain conspicuous positions on certain favored mound-posts; that is, all features of classical territoriality emphasized by students of birds are present in the Pectoral Sandpiper. I may add, however, without extended discussion here, that territory should be defined as an exclusive area, not merely a "defended" one. Armstrong (1947:273) states that "the essential feature of territory is defence . . . ," and a number of authors preoccupied with territoriality in birds, before and since 1947, have pushed a similar view. This is to be noted particularly for Hinde (1956), who, in the latest review of the subject of territoriality, remarked that in its essentials, the concept of territory had not undergone any significant change since Howard (1920). The fundamental importance of territory lies not in the mechanism (overt defense or any other action) by which the territory becomes identified with its occupant, but in the degree to which it is in fact used exclusively by its occupant. This places proper emphasis on the degree to which a population partitions available habitat among its members, at density levels presumably leading to most effective reproduction. It may be claimed, therefore, that functionally territory is primarily an ecological phenomenon and not a behavioristic one, the special antics of birds and the crowds of people studying them having warped the emphasis too much and too long. It is for this reason that data on spacing and the discussion of exclusiveness of occupied territories in the Pectoral Sandpiper have been placed in the first paragraphs of this section, ahead of observations on actions used in maintaining that spacing.

The site of a settled territorial male, once found occupied, can be relocated with a male present again and again. After the breeding season is well started, and in poor weather generally, he will spend many hours quietly on his territory, resting much of the time on one mound or one of several such mounds favored as territorial posts. There he stands as conspicuously as the local terrain permits, and from there he watches his territory. He may be seen napping on such a mound. Feeding occurs in various parts of the territory, and in some instances evidently outside of it, also (see above). At times of chasing or courtship, the male may be seen on his post standing with chest raised and feathers of the back somewhat raised, alert to what is going on around him. I have, however, heard only the routine alarm note from a male on his territorial post, and that only occasionally. There is no vocal announcement from the ground by a territorial male, and special notes which might be significant in a territorial or courtship context have been recorded only rarely.

A male, whether alone on his territory or in association with a female, will take wing to chase an intruder and continue such a chase over as much as 200 yards before turning back. The height of such flights is usually no more than 10 to 15 feet. Observations of a sequence of such chases and turn-backs show that the boundary is a definite one, respected similarly by each of two neighbors, and that the chase rarely continues outside of the territory of the chaser. Encounters indicating fairly definite boundaries were seen on plot 1 but not on plot 3; on the latter, with extensive low wet marsh between areas preferred by males it is likely that the territories were buffered, and chases witnessed took place only occasionally between apparent neighbors.

In situations of territorial aggression, males give a special note which is a harsh, protracted swishing. It is flatulent and loud, seeming best described sometimes as a jabber, at others as a gurgle. This note is rarely given other than in territorial chase on wing. Once, after a male displayed twice on the ground following a female, he chased

her on foot a distance of several feet and gave the jabber note during this chase. It is heard most frequently in the first half of the breeding season in two sorts of situations: (1) when one or several males are closely chasing a female and are chased in turn by a male over whose territory they fly, and (2) when newly arriving birds in small flocks fly over or come to rest scatteredly on an occupied area; in the latter situation the established male may chase several members in succession, reacting similarly to males and females.

In routine announcement, the male takes wing and flies a few feet above the ground, hooting as he courses along one main axis of the territory, then dropping to the ground at the end of the flight. The display typically follows a straight line. He takes wing again and returns to his favorite resting mound. In the course of this return flight, what was described earlier under display number 6 may occur.

In challenges, the hooting display is used when an intruding male flies overhead and the occupant rises and flies beneath him, hooting as the two advance together. Or, the occupant may hoot and threaten (jabber) alternately. Here the occupant drops back to the ground as he reaches the margin of his territory, while the intruder continues his flight, perhaps changing direction when challenge occurs. If a chase occurs and the occupant turns near his boundary to return to his mound, he may display on the return flight.

The flight display is used more or less similarly by neighboring males challenging each other along boundaries or over area not yet partitioned. Two males fly parallel to each other, a few feet or even a few inches apart, and continue thus for a distance of several hundred feet with occasional sidewise movement of one toward the other, hooting most of the way. At the end of the flight they separate, apparently returning to their respective territories. At the beginning of the season when territorial limits are not settled, such challenge displays may occur successively between one male and first one, then another of his neighbors or prospective neighbors. Display challenging with one male coming over the territory of a neighbor only to be chased with display by the latter has been recorded as late as June 26.

Males may also challenge each other on the ground along a boundary. In the best recorded example (June 22, 1955), two males walked side by side, bodies bent forward, chests expanded, bowing every few seconds as they moved, but not giving any calls. They moved back and forth along the "boundary," with mild chase of one by the other intermittently. A short flight occurred to another position on the boundary, the display on foot was resumed, and this was repeated several times through a distance of about 50 feet until they moved well to one side, when a short chase ensued. They then separated and flew in opposite directions, each about 300 feet, and set down on their respective territories. During the alternation of ground display with short flight, one or both males would land on snow patches, thus becoming more conspicuous. This tactic is used in territorial conflict by several other species of sandpipers and by longspurs.

Actual physical conflict is rare among territorial males and was noted but once (June 11, 1953) between a male who alighted on a large snowbank and a second male which immediately approached from the opposite direction. A short fight ensued, whereupon they returned to their respective areas.

THE PAIR RELATIONSHIP

Observations reported here lead one to infer that the male Pectoral Sandpiper may be polygamous or that he establishes a short-term pair-bond but can repeat this several times through a season. The latter now seems to be more likely. Certain relevant observations have already been mentioned (page 239)—the responsibility of the female

alone in nesting, the avoidance generally of male-favored habitat by breeding females, and the departure of males before eggs are hatched. It may be added that males on their territories are observed alone much more frequently than in association with a female. Most of the records of pairs are based on observations over one to three dates, mostly closely successive, so that one infers that the association represents the courtship and egg-laying intervals of a single pairing. At no time was a male seen with more than one female on a territory so that at least for the period required by mating and egg laying, there is now no evidence that the male is any more than monogamous. While marked birds are obviously required to settle this point, it seems likely that were more than one female associating with a male in one interval of time, we would have witnessed this in the field at least a few times.

For five males from the five seasons' data for plot 1 there are records of associations with females two or three times separated by intervals allowing for successful completion of a clutch. This leaves unexcluded the possibility that the small proportion of males providing these records may have been associated with renesting females.

Regarding renesting, this is a moot point. As it is known to occur in the high arctic in such species as the Lapland Longspur (Pitelka MS) and Pomarine Jaeger (Pitelka *et al.*, 1955; Maher MS), it is possible likewise for shorebirds, but we have no bona fide instance in any species from northern Alaska.

Another line of circumstantial evidence which supports the view of a short-term pair-bond is the behavior of males toward females known to be tending nests. Conover (1926:307) mentions that a male may join a female driven from a nest, whereupon he begins courtship display and chases her. I have witnessed this also near Barrow. In such chases, a male will leave his territory and thus encounter other males who may join in the chase or challenge the intruders. In one particular instance of a female known to have a nest with four eggs on plot 1 in 1955, her movements evidently made her particularly vulnerable to local males. On June 28, after I disturbed her, she was chased by three; on July 2 she was chased by six, and within the hour on the same area and presumably involving the same female, a chase with eight males was seen. Size dimorphism facilitates distinction of sexes when they are observed closely in a group. Thus, this behavior also supports the view that males may seek a succession of mates through one season.

Another implication of these observations is that in some situations males may tolerate each other and evidently dispense with territorial isolation while still able to pursue a female. Perhaps it is significant that these observations were made in the last week of the breeding season (earliest record, June 27). If the males can mate without strong territory attachment, even in just a part of the season, the point, while highly conjectural, is of interest in that it suggests an incipiency of conditions which, evolutionarily, may lead to lek organization and to promiscuity as seen in the Ruff.

Finally, a fact entirely consonant with what has been said thus far regarding the pair-relationship in the Pectoral Sandpiper is the degree of sexual dimorphism in size. As figure 4B and table 1 show, males are significantly larger than females. In this respect, *melanotos* resembles the Ruff and not other members of the genus *Calidris, sensu lato,* for which it is stated (Witherby *et al.*, 1940:227) that "females mostly [have] longer bills and sometimes [are] generally larger than males." Suffice it to say that dimorphism in size, color, or other features of structure, or any combination of these, typically occurs in species or groups of species in which the pair relation is brief or limited to mere mating (Sibley, 1957). Thus, on this count also, the Pectoral Sandpiper could represent a stage of evolution which may be antecedent to the more elaborate and specialized stage seen in the Ruff.

Table 1

Sexual Size Dimorphism in the Pectoral Sandpiper

	Males			Females			Size of females expressed as per cent of males using means
	N	Range	Mean	N	Range	Mean	
Wing chord[1]	12	135 –143	139.4 ±0.8	11	120 –131	125.8 ±0.8	90.2
Bill length[1]	11	28.0– 31.7	29.46±0.30	11	25.1– 28.5	27.40±0.33	93.0
Tarsus length[1]	12	28.0– 30.4	29.60±0.20	11	26.1– 29.1	27.40±0.26	92.5
Weights[2]	11	82 –105	94.6 ±1.9	8	61 – 75	65.9 ±2.0	69.6

1 Based on adult specimens collected in late spring and summer in western and northern Alaska, northeastern Siberia, Yukon and British Columbia.
2 Based entirely on June specimens collected in northern Alaska.

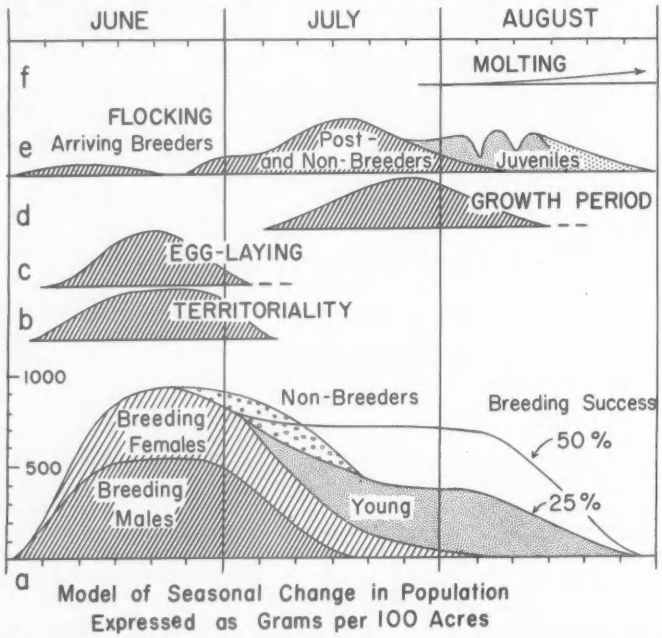

Fig. 7. A generalized schedule of population changes and breeding activities for the Pectoral Sandpiper in northern Alaska.

DISCUSSION

Timing of populational events on the breeding grounds.—Because of the strong size dimorphism between sexes of the Pectoral Sandpiper coupled with the departure of males before nesting is concluded, it is desirable to examine the timing of the main events on the breeding grounds to see whether this will throw any light on populational adaptation. To assist in this, figure 7 has been prepared.

In the Pectoral Sandpiper, unlike the Red-back and other tundra species, most or all of the annual molt occurs well to the south of the breeding grounds. Wetmore (1926:154) records two adult females in which molt had not yet started when they were collected in early September in Paraguay. But in some adults, at least, and in

both sexes on the basis of collected specimens, body molt can begin in the last days of July while they are still on their summering grounds. I say "summering" instead of "breeding" because of the possibility that early inception of molt could be limited to nonbreeders. However, two of three postbreeding adult females (brood patches still evident) collected on August 6, 1925, in Alberta are in early stages of body molt, also. Evidently the main molt period is winter; Wetmore (*loc. cit.*) records two specimens in terminal stages of molt taken in Uruguay in early February. The timing of the onset of molt on the breeding grounds is shown in part of figure 7.

Certain features of timing in breeding behavior have already been discussed in previous sections, and they are included in figure 7 in generalized and summary form. This is done for territoriality (part b), egg laying (c), and flocking (e). The latter part of the flocking curve shows the shift in flock composition from primarily adults to primarily young of the year, and the irregularities in the part of the curve which concerns young suggest the wide variation in their presence in the Barrow area while the regional exodus takes place in the latter part of the summer.

The growth period for young of the year as a group is also shown in figure 7. The latter is based on compiled weight records shown in figure 4B and on dates when young were observed in the field. The combined evidence indicates that the growth period for the bulk of surviving young comes in the latter half of July. With late breeding, as in 1952, the modality would presumably come in early August, but in such years the numbers of young would be only a fraction of what they are in a year that is "average" or at least good from a productional standpoint.

The timing of the growth period takes on greater interest when it is made part of a picture of seasonal change in the composition of the population as a whole. We will assume for the moment that the number of territorial males on a large sample area of diversified breeding habitat is about the same as the number of breeding females. There is no marked unbalance in sex ratio in the breeding population, for the number of breeding females observed never left the impression there were or could be significantly more of them than males. If, now, using information on density discussed earlier, we set up a breeding population of six males and six females per 100 acres, and if we express changes which ensue in grams per 100 acres, we arrive at the picture shown in the lowest part (a) of figure 7. Thus, weight of breeding adults exploiting the tundra is highest in the latter half of June. By the end of June, exodus of males begins. Moreover, a nest may have failed, or females may drop out for this or other reasons. Thus, by early July, the biomass of breeders starts to decline, but the presence of nonbreeders, or postbreeders (unsuccessful) may keep the populational total up through the first part of July. By the third week of July, however, most of the adults are gone, and there remain only females still attending nests or young plus the growing young.

While we have no figures on nest success in this species, the incidence of mortality suffered by young sandpipers generally can be expected to be high, and we can regard an estimate of 25 per cent success as closer to the truth than 50 per cent or any higher figure. The trend of total population biomass when young are added is shown in figure 7. Also a line is inserted to show what the trend would be if success were 50 per cent. The decline starting in early August denotes the migratory departure of surviving young.

This schedule shows that the population bulks in the early part of the summer and that even if we invoke a moderately high level of breeding success (50 per cent), we cannot shift this peak to a later part of the summer. Even if we allow a few more females than six per six males on 100 acres, this shift will not occur without assumptions that run counter to the facts. And, if we have erred in the assumptions behind the model, it is in not allowing for enough failures of nests in the egg stage and for the downward

trend of adult weights shown in figure 4B. In other words, even if we examine certain variables that could shift the peaking of biomass, the pattern remains essentially the same, with the highest weights being supported in late June and early July.

It seems possible that this feature of timing may explain part of the success of the Pectoral Sandpiper as a tundra shorebird, both in its wide distribution over northern Alaska and in its relative abundance in foothill as well as coastal zones. Similar analyses should be made of data on other shorebirds before this interpretation is pursued further. But the picture in another common species, the Red Phalarope, will be similar. Here the females (larger than males) leave and hence the biomass curve may be expected to hump in the latter half of June as it does for the Pectoral Sandpiper. Although the Red Phalarope breeds commonly only on the coastal plain, its numbers there on a given area can exceed severalfold those of any other shorebird species.

It therefore seems to be significant that in two species which are both more common and of larger body size than several other shorebird species with which they co-exist, there is this feature of populational contraction after June. This raises questions of the relation of this contraction to available food.

Preble and McAtee (1923:72) show that dipterous insects comprise more than half of the food of the Pectoral Sandpiper in certain arctic areas. They also note that seeds and algae may be taken, but these must be relatively minor items of diet. Our information on food is summarized in tables 2 and 3. Insects of the groups Diptera, Trichoptera and Coleoptera, and small spiders are taken most frequently, but again the overwhelming importance of Diptera is shown. Most of the dipterous species important as food overwinter and enter the summer as larvae, passing through pupal, adult, and egg stages rapidly through the middle of the summer. There is thus a marked dip in the supply of larvae occurring through late June and the first half of July, in which period the bulk of adult flies emerge. Hence, it appears, first, that the period when most Pectoral Sandpipers and Red Phalaropes are present is the period when insect larvae and pupae are abundant in the wet marshes and pond margins where they mainly feed; and, second, that early departure of adults of the larger sex is in part related to the early July decline of the larval supply.

While Lack's (1954) postulate regarding timing of breeding was developed mainly from studies of altricial birds, even in precocial ones maximal survival may be expected if young grow mainly when food is maximally available. Whether these two periods in fact coincide in the Pectoral Sandpiper remains to be shown. Sampling of surface insects in three habitats through two summers (1952 and 1953) showed a peak in mid-July (Hurd and Pitelka, MS), and it now appears that growth of young Pectoral Sandpipers occurs mainly after this peak of overall food availability. Possibly they exploit particular food items whose supply is not correctly reflected in the overall trend of insect numbers; thus, they may be taking dipterous larvae of the new year-class appearing around August 1. Nevertheless, it is argued (1) that on a population-wide basis, food demands are higher at a time other than that when young are growing most rapidly; (2) that the latter situation is eased by the departure of more than half of the biomass of breeding adults before the young make their chief demands; and (3) that the weights of adults, declining through the summer (fig. 4B), suggest that the food situation does not improve for them through July apart from questions of the welfare of the young. Another point is that the amounts of insect food may be expected to fluctuate widely from year to year because of widely varying weather conditions, and a species which adjusts to this by such populational timing as occurs in the Pectoral Sandpiper and the Red Phalarope gains an advantage over other, even smaller species, both sexes of which remain on the breeding grounds through the summer.

Table 2

Food of the Pectoral Sandpiper at Barrow, Alaska[1]

Animal group	7 stomachs July 6-12, 1952		2 stomachs July 31, 1952	
	Number of individuals[2]	Per cent	Number of individuals[2]	Per cent
Spiders				
Linyphiidae, primarily *Erigone* spp.	105 (5)[3]	10.8		
Diptera				
Tipulidae (all *Prionocera Gracilistyla* Alex).				
pupae	71 (4)	7.3		
adults			7 (2)	3.0
Chironomidae				
larvae	275[4](3)	28.4		
adults	400 (2)	41.3		
Muscidae, pupae	50 (1)	5.1		
Coleoptera				
Dytiscidae (all *Agabus moestus* Curtis), adults	3 (1)	0.3		
Staphylinidae (*Micralymna brevilingue* Schiødte), adults	40 (2)	4.1		
Carabidae, adults	25 (2)	2.3		
Trichoptera [all *Grensia praeterita* (Walker)]				
adults			230 (2)	97.0
	969		237	

1 For the data summarized in tables 2 and 3, special thanks are given to Dr. Paul D. Hurd, Department of Entomology, University of California, Berkeley.
2 Numbers in excess of 10 are estimates only.
3 Figures in parentheses indicate number of stomachs in which item was found.
4 Total for chironomid larvae probably too low because of difficulty in estimating number from a mass of semi-macerated material; it may have been as high as 400. From one stomach, the mass of chironomid larvae weighing 1.3 grams contained 200-300 individuals.

If these arguments are valid, it is evident that Pectoral Sandpipers time their breeding and migratory movements as parts of a total schedule adapted to the arctic summer. Elsewhere (Pitelka, 1958), I have maintained that in some species timing of breeding in relation to food may be compromised by the energy needs of molt. Here we have another set of conditions involving compromises. In the Pectoral Sandpiper, food available to growing young is presumably augmented to a significant degree by the arrangement that males leave in the first half of July, and females leave later but before the young. Hence any analysis of the timing of breeding must take into account this adaptation. Evolutionary compromises in timing may be expected because of various pressures to which the population is subject simultaneously, serially, or both; that the Pectoral Sandpiper and Red Phalarope have met such pressures with success is strongly indicated by their abundance.

An alternative view regarding the timing shown by breeding populations of Pectoral Sandpipers is that it is an adaptation reducing impact of predation. Near Barrow, the important predators depend on lemmings (Pitelka, Tomich, and Treichel, 1955), and in the absence of the latter, predators are present in such low numbers that any take of Pectoral Sandpipers would be insignificant. When Pomarine Jaegers are nesting, they may turn to shorebirds as alternative prey but they do not do this on a sustained basis (Maher, MS).

It is probable, however, that farther inland, where foxes are present through the summer and where both these and weasels occur more consistently than they do near the coast, predation becomes more important. It is even probable that predation can

be a critical factor in the welfare of foothill populations of the Pectoral Sandpiper. From interior sectors of the Colville River, Cade (MS) reports only low frequency percentages of this species in prey samples of the two breeding falcons (*Falco peregrinus* and *F. rusticolus*), about two per cent by items and less than one per cent by weight. However, in areas where jaegers, particularly *Stercorarius parasiticus*, nest, predation may become more significant. Moreover, on the Kaolak (Maher) and Meade rivers, carcasses of both adult and young Pectoral Sandpipers have been found at fox dens.

Hence, some evidence supports the suggestion that predation may have been a factor in the evolution of the population timing now characterizing the species. The negligible amount of predation in the Barrow region would not itself be an argument against this view if predation does in fact act in a more sustained manner over inland and larger parts of the species' breeding range where the predator fauna is larger and more diversified.

I do not, however, subscribe to the role of predation acting on a population as an alternate to the interpretation given above, and in my opinion, it is not possible to invoke predation strongly in these and other examples (as in the Kittiwake; see Cullen, 1957) when interpreting phylogenetic trends without examining attendant relations between prey and its own food supply. Timing evolves as changes in food supply, in time and space, bring forth adjustments in the annual cycle and behavior of the species such that survival of young is maximal and the population continues at least to main-

Table 3

Food of the Pectoral Sandpiper at Hooper Bay, Alaska[1]

Animal group	8 stomachs May 21-29, 1924	3 stomachs June 6-21, 1924	1 stomach August 30, 1924
Spiders			
Linyphiidae, primarily *Erigone* spp.	3 (2)[2]	3 (1)[2]	
Lycosidae, *Tarentula*	2 (2)	2 (1)	
Diptera			
Tipulidae			
Prionocera sp., larvae	74 (6)	24 (2)	4
Tipula carinifrons, adults		12 (1)	
Chironomidae, larvae	25 (4)	1 (1)	32
Muscidae, pupae	1 (1)		
Anthomyiidae, adults		1 (1)	
Coleoptera			
Dytiscidae, *Agabus* sp., adults	5 (5)	2 (2)	
larvae	5 (4)		
Carabidae, adults, primarily *Amara* sp.	16 (6)	7 (2)	fragments
Chrysomelidae, *Chrysomela* sp., adults	3 (3)	1 (1)	
larvae		1 (1)	
Hemiptera			
Saldidae, *Chiloxanthus* sp.	3 (1)	1 (1)	
Trichoptera, *Micrasaema* sp., larval cases	4 (2)	1 (1)	
Hymenoptera			
Ichneumonidae, adult		1 (1)	
Gastropoda, small snail	1 (1)		
Other contents:			
Seeds	94 (6)	12 (2)	
Gravel, pieces	20 (5)		
Plant remains	1 (1)	1 (1)	

1 Data summarized here were obtained from stomachs originally in the collections of the Fish and Wildlife Service and kindly donated for this study by W. J. Hamilton III.
2 Figures in parentheses indicate number of stomachs in which each item was found.

tain itself. The predation view implies that were the adults of the Pectoral Sandpiper to remain on the breeding grounds to the end of the summer, the species would be less common or absent. If the timing arrangement characteristic of Pectoral Sandpipers and Red Phalaropes is the chief reason for their abundance as tundra shorebirds, then it is possible that predation could have assisted the evolutionary transition since escape from predators by early departing breeders would be one source of improved survival. But surely the change in the food situation would be a more potent source of improved survival for their young. The question really remaining is whether the modifying effect of reduced predation could of itself account for the abundance of these two shorebird species. A critical test of this and other aspects of the problem would be information on kind of food eaten by young sandpipers, on their survival in relation to available food, and on changing techniques in food hunting as they grow.

Generic relationships.—Among the members of the genus *Erolia,* the only species for which the available information clearly suggests relationship with *melanotos* is *fuscicollis,* the White-rumped Sandpiper. This small *Erolia,* surprisingly enough, appears to parallel *melanotos* in several respects, according to the observations reported by Sutton (1932). Thus, the female alone incubates. The males gather in flocks and leave the breeding grounds before appearance of young. Lastly, and perhaps most significantly, the males show swelling of the neck and upper chest as a part of their display and also give a "guttural rattle" that may be equivalent to the aggressive note of territorial Pectoral Sandpipers. In certain details of flight display given by Sutton, however, the White-rump appears to resemble other erolias. Also, it does not show the marked size dimorphism between sexes seen in *melanotos.* In the White-rump, therefore, we may have a species which is more or less intermediate between *melanotos* and less specialized members of *Erolia* (or *Calidris*) such as *bairdii* and *alpina.* However, Sutton is the only observer who describes breeding behavior of *fuscicollis* in any detail, and additional observations are needed. If his are confirmed, then Witherby *et al.* (1940:269) are in error when they say that the habits and behavior of *fuscicollis* "seem to be almost exactly like Dunlin's" (*E. alpina*).

The Sharp-tailed or "Siberian Pectoral" Sandpiper, *Erolia acuminata,* cannot be drawn into this brief discussion as no information is available regarding its breeding biology and displays (Dementiev *et al.,* 1951). However, the weak size dimorphism of the sexes combined with certain features of coloration and pattern lead me to doubt that it is as close to *melanotos* as has been thought heretofore.

The possibility that *melanotos* may be linked with *Philomachus* (or "*Machetes,*" a generic name used earlier) has been mentioned in the introduction and elsewhere in the foregoing text. After the writing of most of this paper was completed, it was found that Dementiev *et al.* (1951) likewise say of *melanotos* that its habits and external appearance remind one of the Ruff. The relationship of the Ruff to *Erolia* (or *Calidris*) was shown some time ago by Lowe (1915*a*, *b*) on the basis of characters of plumage pattern and skull morphology. Ridgway's (1919) synopses of generic characters for "*Machetes*" and "*Pisobia*" (the latter presently included in *Erolia*) also suggest similarities. And finally, what Witherby *et al.* (1940) and Armstrong (1947) alone have to say regarding display behavior of the Ruff suggests still additional similarities. However, without comparative studies, these suggestions cannot be pursued further; for, as Portenko (1957) states, *Erolia* is evidently a heterogeneous assemblage, and this should be even more true of the more inclusive genus *Calidris.*

With these remarks I do not wish to alarm any conservative by a prospect that *Philomachus* and some part of *Calidris* might be lumped. In the former, the sternum has only one pair of incisions; in *melanotos* and other members of the latter, there are

two. Such differences combined with the high degree of dimorphism and the special features of behavior associated with it indicate that *Philomachus pugnax* may well remain in a monotypic genus. The point now is that *melanotos* may fall as close or closer to such a member of the calidrine complex as it does to other members of the A.O.U. Check-list's genus *Erolia*. Thus, in this view, shared by F. S. Andersen (1951), *pugnax* would be one endpoint in the evolutionary diversification of the calidrine sandpipers in which arena display and associated features of breeding behavior are evolved to a degree unmatched by other members of the group, and *melanotos* could represent a stage in that evolution. The interest attached to behavioral parallelism between the Ruff and other lek birds such as grouse (Armstrong, 1947) emphasizes the opportunity afforded by the Calidrinae, and comparative study of *melanotos* and its relatives may reveal something about evolutionary origins of lek behavior in this group.

SUMMARY

Several population characteristics of the Pectoral Sandpiper (*Erolia melanotos*) on its breeding grounds in northern Alaska are described, especially numbers, breeding schedule, and territoriality. Unlike any other shorebird species occurring on the arctic Alaskan slope, the Pectoral Sandpiper is common in both coastal and foothill zones, but at least near the coast, large year-to-year differences in relative abundance may occur. In the breeding season, the species is dispersed generally over coastal tundra, the males occupying territories where low promontories are available, the females nesting in virtually all habitats providing grassy cover. They are primarily insect predators; in early July, near Barrow, dipterous insects comprised at least 75 per cent of the prey.

From data gathered on census plots for five seasons (1951–53, 1955–56), usual or "average" densities were estimated at 5 to 6 breeding territories of males per 100 acres. The minimal density observed was 3 per 100 acres, in 1952, the maximum, 10–15 per 100 acres, in 1953. Numbers of breeding males in 1953 was four or five times that for 1952, the densities for the other three years falling in between. Numbers of females were about the same. Nests are placed without direct relation to territories of males and usually away from them. The pair-bond is short, and once nesting is started, females are independent of males.

Eggs may be laid over a period as long as a month, from early June to early July. Near Barrow most eggs are laid in the last ten days of June. In the interior the period is probably of the same length, but the modal interval falls about a week earlier. Testis size is maximal for about five weeks from early June to early July; testes regress over about three weeks in July and early August.

The seasonal trend in numbers in relation to breeding schedule can be divided into six phases: (1) early summer rise in numbers of settled birds; (2) interval of relative stability when territories are occupied and when most eggs are laid; (3) desertion of territories by males, in late June and early July; (4) completion of incubation by females and care of recently hatched young; (5) departure of females in late July and early August; and (6) departure of juveniles from late July to the first days of September. Flocking is most conspicuous in July when the numbers of both breeders and nonbreeders moving about in early stages of migratory departure are greatest. A striking amount of flocking in 1952 in conjunction with the low breeding densities of that year indicates that near the coast, at least, this was not a productive year.

The flight display of territorial males and seven other displays are described briefly. Males isolate themselves on areas used for pairing (and probably mating), feeding, and roosting. These areas support females similarly during their short period of association with the male. Territory size is estimated at 10 to 15 acres. The period of territorial

occupation is about a month long, from early June to early July; number of established males reaches a peak in the third week of June. With respect to patterns of space occupation and aggressive behavior as well as other features, the behavior of the male Pectoral Sandpiper is analogous to that of other well-known "classically" territorial species. There is no evidence for territoriality in females.

A model of the seasonal schedule of biomass per unit area for Pectoral Sandpipers shows that the peak is reached in the early part of the summer, in late June. The main populational contraction occurs during July. This appears to be an adaptation which acts to improve the food situation for young and hence for their survival; that is, it is a populational timing mechanism superimposed on any relation between periods of active growth in young and of maximal food supply for them. This interpretation of the midsummer contraction in numbers is preferred over the alternate view that the contraction has been selected evolutionarily because it reduces losses to predation.

The question of generic limits in sandpipers is discussed briefly because of the evidence that *"Erolia" melanotos* is not closely related to many of its congeners. Certain features of breeding organization in the Pectoral Sandpiper suggest antecedents to the lek behavior of the Ruff.

LITERATURE CITED

American Ornithologists' Union
1957. Check-list of North American birds. 5th ed. (published by the Union, Baltimore, Md.).
Andersen, F. S.
1951. Contribution to the biology of the ruff (*Philomachus pugnax* (L.)) III. Dansk Ornith. Foren. Tidsskrift, 45:145–173.
Armstrong, E. A.
1947. Bird display and behaviour (Oxford Univ. Press, New York).
Bailey, A. M.
1948. Birds of arctic Alaska. Colorado Mus. Nat. Hist., Popular Series No. 8:1–317.
Baldwin, P. H.
1955. The breeding ecology and physiological rhythms of some arctic birds at Umiat, Alaska. Final Report, Arctic Inst. N. Amer., 112 pp. (mimeographed).
Bee, J. W.
1958. Birds found on the arctic slope of northern Alaska. Univ. Kansas Publ., Mus. Nat. Hist., 10:163–211.
Bent, A. C.
1927. Life histories of North American shore birds. Bull. U. S. Nat. Mus., 142:x+420 pp.
British Ornithologists' Union
1952. Check-list of the birds of Great Britain and Ireland (London).
Britton, M. E.
1958. Vegetation of the arctic tundra. (*In* Arctic Biology, Oregon State College Biology Colloquium, 1957:26–61.)
Brooks, W. S.
1915. Notes on birds from east Siberia and arctic Alaska. Bull. Mus. Comp. Zool., 59:359–413.
Buturlin, S. A.
1907. On the breeding habits of the rosy gull and the pectoral sandpiper. Ibis, 1907:570–573.
Conover, H. B.
1926. Game birds of the Hooper Bay region, Alaska. Auk, 43:162–180, 303–318.
Cullen, E.
1957. Adaptations in the kittiwake to cliff-nesting. Ibis, 99:275–302.
Dementiev, G. P., Gladkov, N. A., and Spangenberg, E. P.
1951. Ptisy Sovetskogo Soyuza. Vol. 3 (Moscow).
Gladkov, N. A.
1957. Der Rotkehlige Strandläufer (*Calidris ruficollis*) ist eine selbständige Art. Jour. für Ornith., 98:195–203.

Hamilton, W. J., III
1959. Aggressive behavior of migrant pectoral sandpipers. Condor, 61:161–179.
Hinde, R. A.
1956. The biological significance of the territories of birds. Ibis, 98:340–369.
Howard, H. E.
1920. Territory in bird life (London).
Kendeigh, S. C.
1944. Measurement of bird populations. Ecol. Monog., 14:67–106.
Kessel, B., and Cade, T. J.
1958. Birds of the Colville River, northern Alaska. Biol. Papers, Univ. Alaska, No. 2: iv+83 pp.
Lack, D.
1954. The natural regulation of animal numbers (Oxford Univ. Press).
Lowe, P. R.
1915*a*. Coloration as a factor in family and generic differentiation. Ibis, 1915:320–346.
1915*b*. Studies on the Charadriiformes.—I. On the systematic position of the ruff .... Ibis, 609-616.
Murdoch, J.
1885. Birds (*In* P. H. Ray's "Report of the International Polar Expedition to Point Barrow, Alaska." pp. 104–128), Washington, D. C.
Nelson, E. W.
1884. The breeding habits of the pectoral sandpiper (*Actodromas maculata*). Auk, 1:218–221.
Pitelka, F. A.
1951. Ecologic overlap and interspecific strife in breeding populations of Anna and Allen hummingbirds. Ecol., 32:641–661.
1958. Timing of molt in Steller jays of the Queen Charlotte Islands, British Columbia. Condor, 60:38–49.
Pitelka, F. A., Tomich, P. Q., and Treichel, G. W.
1955. Ecological relations of jaegers and owls as lemming predators near Barrow, Alaska. Ecol. Monog., 25:85–117.
Pleske, T.
1928. Birds of the Eurasian tundra. Mem. Boston Soc. Nat. Hist., 6:111–485.
Portenko, L. A.
1957. Studien einigen seltenen Limicolen aus dem nördlichen und östlichen Sibirien. I. Jour. für Ornith., 98:454–466.
Preble, E. A., and McAtee, W. L.
1923. Birds of the Pribilof Islands, Alaska. N. Amer. Fauna No. 46:10–101.
Ridgway, R.
1919. The birds of North and Middle America. U. S. Nat. Mus. Bull. 50, pt 8.
Sibley, C. G.
1957. The evolutionary and taxonomic significance of sexual dimorphism and hybridization in birds. Condor, 59:166–191.
Southern, H. N., and Lewis, W. A. S.
1938. The breeding behaviour of Temminck's stint. Brit. Birds, 31:314–321.
Stone, W. S.
1900. Report on the birds and mammals obtained by the McIlhenny expedition to Pt. Barrow, Alaska. Proc. Acad. Nat. Sci. Phila., 1900:40–49.
Sutton, G. M.
1932. The birds of Southampton Island. Mem. Carnegie Mus., vol. 12, part II, sec. 2:1–275.
Wetmore, A.
1926. Observations on the birds of Argentina, Paraguay, Uruguay, and Chile. Bull. U. S. Nat. Mus., 133:iv+448 pp.
Witherby, H. F., Jourdain, F. C. R., Ticehurst, N. F., and Tucker, B. W.
1940. The handbook of British birds. Vol. 4 (H. F. and G. Witherby Ltd., London).

Museum of Vertebrate Zoology, University of California, Berkeley, California, December 1, 1958.

OBSERVATIONS ON THE CATTLE EGRET IN COLOMBIA

By F. C. LEHMANN V.

In a recent publication (Lehmann, Nov. Colombianas, no. 3, 1957:107) I mentioned that African Cattle Egrets (*Bulbulcus ibis ibis*) seemed to be established in the plateau of the Department of Cauca Valley in Colombia, since I had observed them in numbers there for some time, the year around, and under circumstances that indicated that the birds were permanent residents rather than migrant visitors. But I also pointed out that in spite of their abundance and permanence it had not been possible for me to find any nests.

Shortly afterward, in April of 1958, I was informed by Mr. F. Restrepo-White that egrets were nesting in large numbers near the town of Tuluá, 80 miles north of Cali. I went immediately to the place, where a month earlier I had seen from some distance what I took to be a heron roosting place. On this last occasion I found a beautiful nesting colony of Cattle Egrets established in a very large and tall samán tree (*Samanea saman*), not far to the southeast of the town. The colony consisted of some 300 to 350 nests in different stages of development. Some were being built at the time, and the birds were very active carrying building material that consisted of sticks, twigs, and even large branches and small bushes. Certain of these objects were too bulky and heavy for their carriers and had to be dropped from the air when the birds could not reach the height of the nesting place. At other times the birds had to circle to gain altitude to reach the nests with their load. There was feverish activity, and the noise and cackling of the birds was almost deafening. To judge from the birds' antics, many nests contained eggs, some of which were being tossed out by the pugnacious egrets that kept chasing each other from the nests. Many more nests were occupied by young birds, which ranged from recently hatched juveniles to those that were almost ready to leave the nest. There were also some young ones following their parents in short flights.

The ground under the tree was literally covered with egg shells, twigs that were being re-used by birds that came down for them, dropped food, live young, and dead nestlings too young to survive the fall. And there were of course droppings and regurgitated pellets.

The owner of the farm on which this colony was established informed me that the birds had started their colony there sometime in January or early February (the moderately dry season here) of this year for the first time. This visit gave me an opportunity to take some pictures of the colony and of some of the life that was going on it in.

On April 24, I had the privilege of the company of Alden H. Miller on a visit to another colony of Cattle Egrets near Guacarí, about 50 miles north of Cali and 30 miles south of the other colony visited earlier. Perhaps it is worth mentioning here that both these colonies are near the base of the Central Andes, on their western side, where they get all the afternoon sun. Both also are located not more than 100 yards from farm houses where there is constant activity of all sorts, even including that of heavy agricultural machinery. The birds seem not to be much disturbed by the presence of people. Of course when one approaches the colony, some of the birds take to the air, but they return shortly afterward to their respective places.

This second colony was located for the most part on two low, but large chiminango trees (*Pithecellobium dulce*); but it extended also to a tall, dead gualanday tree (*Jacaranda*), that had been killed by the birds and to a young samán, not as large as the one on which the first colony was established, but larger than the other three trees. This new colony was in about the same stage of activity as the first one. Dr. Miller and I

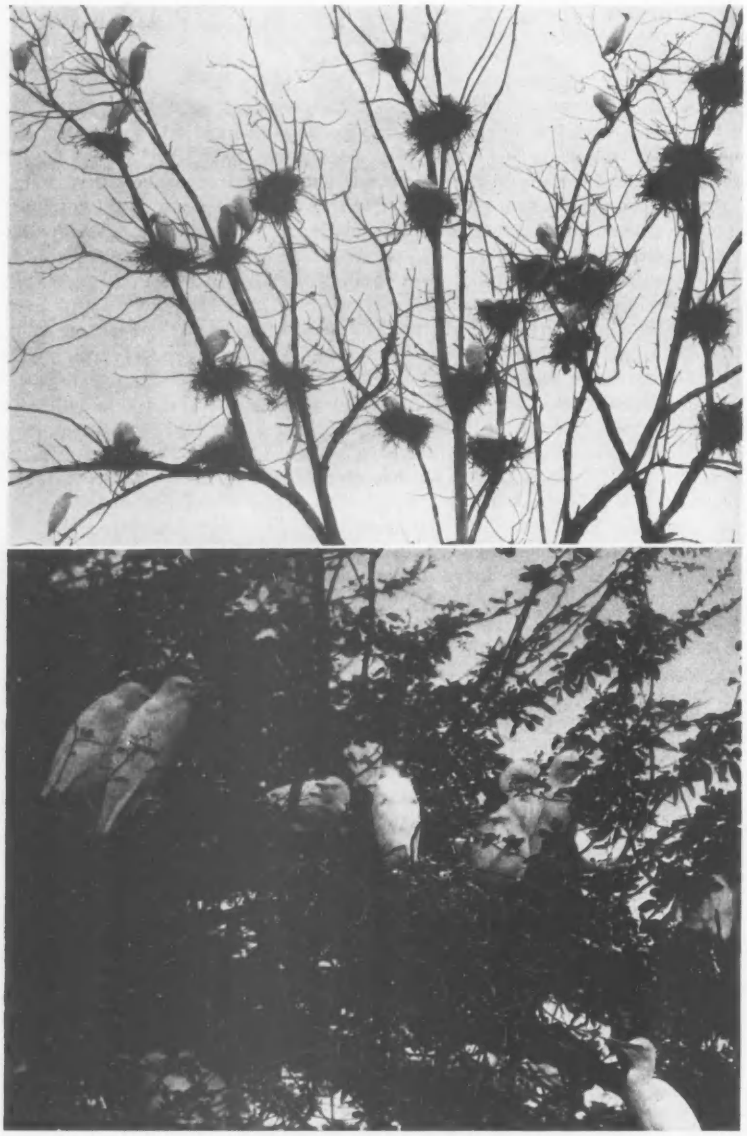

Fig 1. Nesting colony of Cattle Egrets about 50 miles north of Cali, Colombia, April, 1958. Upper: leafless tree showing how some nests in the colony are unprotected from rain or sun. Lower: close-up view of nests and adults in another tree.

estimated that it contained about 500 nests. The lower location of some of the nests here permitted better observation. In both colonies the larger young birds found on the ground looked strong and healthy; they probably were feeding upon food dropped from above, or else were being fed by their parents. Smaller young were starving and some were found dead. Others managed to climb back along low branches and eventually reached their nests in this second colony.

We were told by Messrs. Jaramillo, the ranch owners, that this colony had been established there two years ago, and they showed us two big dead ceibas (*Ceiba pentandra*) that were occupied by the birds in the beginning and which died because of the bird invasion. Also they stated that the birds had been nesting there continually since the beginning. This constant breeding seemed quite unusual to us, so I decided to pay a later visit to the place and verify this matter. Accordingly on December 7 I drove to the site to find that the birds were still abundant there, early in the afternoon. Possibly over one hundred birds were seen, but I found that only very few old nests remained, four or five of which had apparently been recently abandoned; only one contained a full-grown nestling, well feathered, that followed the parents along the branches begging for food, to return immediately to the nest and go out again, calling continually. Most of the birds present now were young, with black bills; there were fewer yellow-billed adults.

At about five o'clock in the afternoon started the parade of flocks of birds coming to roost at this place. These flocks consisted of from 5 or 6 to 25 or 30 egrets each, and what at the beginning was a small flock every three to five minutes developed into an almost continuous stream of white forms, the flocks being larger and spaced a few hundred yards, sometimes less than fifty yards apart. Most of the birds came from one direction only, north-northwest in this instance. The new comers settled on the same trees that were already occupied by the earlier arrivals.

My limited observations suggest that the Cattle Egrets here have a period of rest during which they do not carry on breeding. No activity was observed in the course of the whole afternoon that would indicate any new building of nests or any breeding behavior. What probably happens is that the birds do not abandon completely their nesting site in the course of the year but use it as a roosting place while not breeding. An untrained observer would not realize that the birds are not actually breeding, in spite of the differences in noise and performances of them.

Another observation worth reporting here is that a pair of Snowy Egrets (*Leucophoyx thula*) was established among the Cattle Egrets during the peak of the nesting period. The Snowy Egrets were in the very middle of the most densely populated tree. This single pair seemed not to bother or be disturbed by the Cattle Egrets. Members of this pair were in full nuptial dress, but I could not detect any breeding behavior in them, except that they were perched quite close together and displayed their plumes.

In the second Cattle Egret colony some nests had from one to three chicks, but mostly two; in many instances the young were quite different in age, indicating perhaps some delay in the laying of the second eggs. The nests are relatively small and when the young attain some development there is scarcely room for them. The parents then stand guard from a nearby branch. When the young reach a larger size, they desert the the nest and perch on the adjacent branches along which they run to meet their parents quickly and receive food from them.

Feeding of the young seems to be carried on all day long in the colony without noticeable difference in activity at different hours of the day. Of course at times the parents perch and rest for long periods near their offspring. The chicks show an insatiable hunger

and seem to be desperate to be fed. Frequently two young beg to be fed at the same time, practically attacking the feeder.

On the trees that have lost their leaves because of having long been used for nesting sites, the nests stand completely unprotected from rain or from the intense tropical sun. In some instances the young can be seen trying to protect themselves by approaching a branch that casts some shadow (fig. 1).

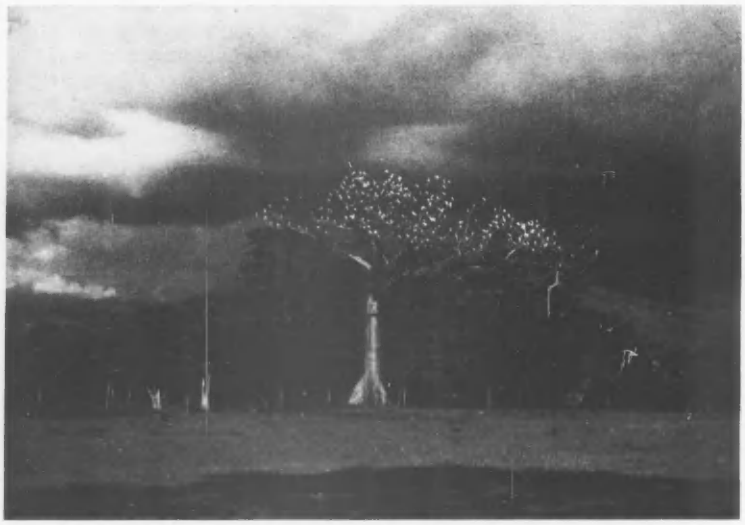

Fig. 2. African Cattle Egrets (*Bulbulcus ibis ibis*) roosting in a ceiba tree about 50 miles north of Cali, Colombia.

In my second visit to the Guacarí colony I observed that one of the ceiba trees originally used by the egrets as a nesting site had been cut down as dead some time earlier, but the other ceiba, to my surprise was coming back to life and showed many new leaves on its eastern side. It was at that time seldom used by the egrets, and then only as a resting place (fig. 2).

In contrast to what has been recorded recently (Haverschmidt, Ardea, 45, 1957: 168–176) on the roosting habits of Cattle Egrets in Surinam, Messrs. Jaramillo and family inform me that at about 7 p.m. all activity stops completely in the colony and no more noise or cackling is heard during the night-time hours. Haverschmidt also suggests the possibility that these egrets nest in Surinam in the vast marshes on both sides of the Nannicreek. Such use of marshes may occur there, but it is interesting to note that in Colombia in general, as far as my personal observations show, these birds prefer dry country and recently planted rice paddies to marshy areas. The two colonies of breeding birds are found on solid ground with no marshes for several miles around, but both colonies are located above small artificial water supply channels.

The distribution and spread of the Cattle Egret in Colombia is reflected by several recent observations. During a study and collecting trip to the Llanos (plains) of eastern Colombia in February and March of 1958, I many times observed Cattle Egrets, not in

great numbers, but usually in small flocks of from 5 to 20 at the most. I collected two for the record.

More recently in the upper Putumayo area in the Amazon basin, about 50 miles east of the base of the Andes in the low flat country covered with Amazonian jungle, and in grazing land recently opened up there, I was surprised to see Cattle Egrets. The first time I saw a solitary bird; later on I located a small flock of about 30. This shows how the invasion of this continent is being carried out by the newcomers. These birds in the Putumayo area have probably reached this corner of the Amazon forest by following the large rivers to the west. Mr. M. A. Carriker, Jr., who collected the first known specimen of the Cattle Egret for Colombia, reports that in December, 1958, in the Caquetá region southeast of Florencia, he several times observed a flock of Cattle Egrets of more than two hundred individuals across the river from Venecia on the way to Montañita. Here he observed them going along with the cattle and in pastures that were dry.

In Popayán a flock of about 60 has been observed in November and December of 1958. This group comes every night to roost in the tallest trees of the main plaza.

The Cattle Egret still remains to be found in the Department of Nariño and in the Patía Valley in Colombia. I would not be surprised to see it in that area soon by invasion through the upper plateau of Popayán; by this route they could follow the Patía River to Nariño and the Pacific. Two captive birds which I observed at a school of the Mary's Brothers in Pasto, Nariño, were taken near Palmira, Valle, according to the information given by the Brother in charge.

To summarize, the Cattle Egret has been observed in Colombia on the Atlantic coast, in the Magdalena Valley, on the Llanos, in the Cauca Valley, and in the northern part of Cauca Department; also it has been reported by Dugand (Lozania, no. 8, 1954:1–7) in Santander and on the Savana de Bogotá. Now with the present reports for the Caquetá and Putumayo areas in southern Colombia, it can be said that with exception of Nariño its range covers almost all the country.

In so far as I know, Colombia is the third country in South America where the Cattle Egret has been found breeding. The other two countries are British Guiana and Surinam (Haverschmidt, *loc. cit.*), both in the northeastern part of the continent. The Cauca Valley in Colombia is the westernmost point of occurrence.

I am deeply indebted to Alden H. Miller for his advice and help in many ways connected with the observations and the manuscript.

Department of Zoology, Faculty of Medicine, Universidad del Valle, Cali, Colombia, December 10, 1958 (Contribuciones al Estudio de la Fauna de Colombia XIII).

LIVER LIPIDS IN HUMMINGBIRDS

By FRANK A. HARTMAN and KATHARINE A. BROWNELL

In order to maintain a body temperature above that of their environment, warm-blooded animals must have a constant supply of fuel which comes from recently digested food or from material previously stored. Such storage is primarily in the form of fat. Therefore the determination of the amount of fat gives the most accurate measure of the ability to withstand periods of excessive environmental demand or inadequate food supply.

Because birds have a higher body temperature and are at times subjected to greater demands than mammals, it is important that they have a readily available supply of fuel. Therefore fat deposits in birds are of great importance and should receive more attention than has been given them. Many casual observations on fat have been made in connection with other studies, but quantitative determinations are relatively few and these are mostly in relation to migration.

Because of the difficulty in determining total body fat, and because such deposits represent less readily available stores, it was thought that determination of liver lipid might indicate the importance of fat in the metabolism at a given time. The fat of the liver is that proportion of the total lipids which is being processed either for storage or immediate use. Moreover, it has been shown by Odum and Perkinson (1951) that the amount of liver fat reflects the amount of total body lipid.

The hummingbirds, one of the most active types of birds, possess such large amounts of lipid in the liver that this organ in them frequently becomes creamy white in color. Because of this observation we became interested in determining the actual amount of lipid present. This has been compared with the values in other birds.

ACKNOWLEDGMENTS

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METHODS

Birds shot in the field were enclosed in sealed vials or waterproof bags until they reached the laboratory. They were then weighed on a torsion balance sensitive to 2 mg. The livers were weighed on a Roller-Smith precision balance sensitive to 0.02 mg. For determination of body lipids (lipids include fats and a small quantity of other compounds soluble in the solvents used), the head, feathers, feet, and gastro-intestinal tract were removed; the remainder of each specimen was cut into small pieces for later grinding and extraction. All material for lipid determination was preserved for analysis in redistilled ethyl alcohol. Subsequently, this material, liver or body, was ground to a pulp with sand. The pulp was thoroughly extracted with a boiling 3 to 1 alcohol-ether mixture as suggested by Bloor (1943). After removal of the solvent, the residue was extracted with boiling petroleum ether. The ether was removed and the residue, determined gravimetrically, is reported as total lipid.

Hummingbirds were collected in Panamá in January and February both at sea level and at elevations of 4500 and 7000 feet. Other specimens were collected in Oxford County, Maine, in July, August, and September.

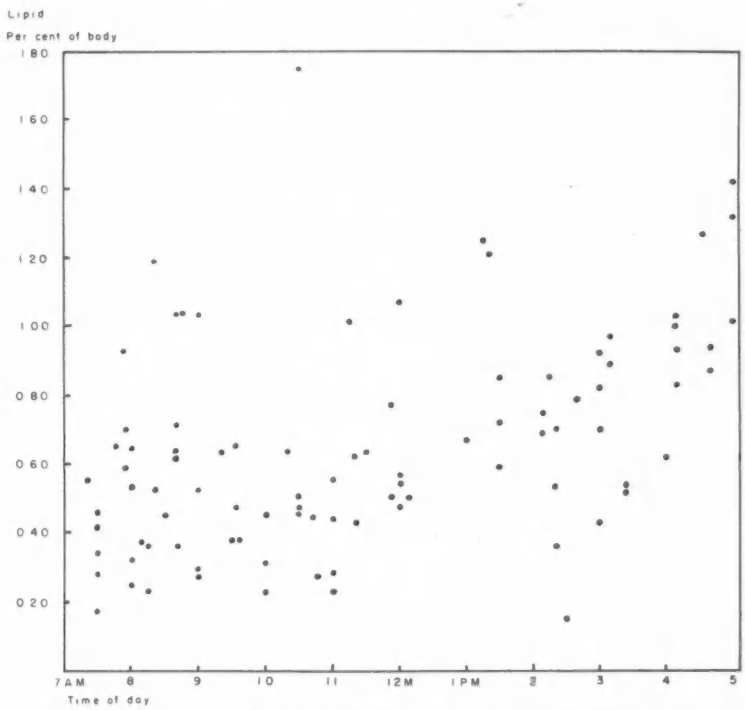

Fig. 1. Liver lipid as per cent of body weight in various species of hummingbirds collected at different times of the day.

RESULTS

The liver and its lipid in hummingbirds.—The two most common species of hummingbirds used in our study were the Rufous-tailed Hummer (*Amazilia tzacatl*) and the Scintillant Hummer (*Selasphorus scintilla*). They were represented by 15 and 12 individuals, respectively. In these species there was no significant difference in liver weights between the sexes or between specimens collected in the morning or afternoon. This was due to the great range in values. On the other hand, if we consider all specimens of hummingbirds collected at sea level, the liver averaged 3.35±0.14 per cent of the body weight before noon and 3.88±0.16 per cent after noon. This difference is significant ($p<0.05$).

The amount of lipid in the liver frequently ranged from 15 to 30 per cent of liver weight. These high values account for the creamy color of the liver. The range of values was determined from more than one hundred individuals distributed among 22 species, collected at different times of the day at elevations ranging from sea level to 7000 feet. Figure 1 shows more than 90 of these determinations. The afternoon values tend to be higher than those in the morning. Except for a few very high morning values the trend does not start upward until after 11 a.m. It then continues upward until 5 p.m. when the last values were obtained. If a median is run, it starts at about 0.50 per cent of body

weight in the morning, and is 0.60 per cent at noon, 0.70 to 0.80 per cent at 3 p.m., 0.90 per cent at 4 p.m., and over 1.0 per cent at 5 p.m.

Because of the difference associated with elevation, we recalculated the values for birds from sea level alone. They are 0.37±0.03 per cent (23 specimens) for the forenoon and 0.87±0.05 per cent (22 specimens) for the afternoon.

A breakdown of the species represented by five or more individuals is given in table 1. It can be seen that all show an increase in the afternoon except *Selasphorus*, which was also high in the morning. Species represented by fewer than five individuals conformed more or less to the general pattern. They were *Amazilia amabilis* (3), *Amazilia decora* (2), *Anthracothorax nigricollis* (2), *Chalybura buffonii* (1), *Eugenes spectabilis* (1), *Elvira chionura* (2), *Heliodoxa jacula* (1), *Campylopterus hemileucurus* (3), *Phaethornis longuemareus* (1), *Phaethornis superciliarus* (1), *Phaethornis guy* (3), *Florisuga mellivora* (1), *Colibri thalassinus* (3), and *Eupherusa eximia* (4).

Table 1

Average Values for Liver Lipid in Hummingbirds
(numbers of individuals in parenthesis)

Species	Body weight in grams	Liver lipid as per cent of body weight a.m.	p.m.
Selasphorus scintilla	(9) 2.27±0.07*	(9) 0.71±0.06	(3) 0.75±0.02
Chlorostilbon canivetii	(5) 3.07±0.02	(2) 0.31	(5) 0.71±0.08
Damophila julie	(5) 3.23±0.07	(2) 0.35	(3) 0.75±0.17
Amazilia edward	(8) 4.56±0.04	(6) 0.43±0.01	(2) 0.81
Amazilia tzacatl	(16) 4.94±0.04	(4) 0.41±0.11	(12) 0.93±0.09
Lampornis castaneoventris	(8) 5.31±0.04	(5) 0.44±0.08	(3) 0.58±0.02
Glaucis hirsuta	(5) 6.26±0.12	(4) 0.29±0.06	(1) 0.92
Phaeochroa cuvierii	(6) 8.93±0.06	(3) 0.36±0.11	(3) 0.57±0.17

*Standard error.

Since few birds were collected in the afternoon at high altitudes, only those collected before noon are used in comparing the values at different elevations. The liver lipid of 39 specimens obtained at 4500 feet above sea level was 0.66±0.05 per cent of the body weight. Compared with the birds from sea level already mentioned, this is almost double their value. It might be pointed out that *Selasphorus* was collected at 7000 feet above sea level.

It is interesting to note that a hummingbird (*Chlorostilbon*) weighing 3.08 grams, wounded at 3:25 p.m. and kept in the dark for 22 hours, contained liver lipid after that time which amounted to 0.68 per cent of the body weight.

Lipids of both the liver and body were determined in 21 hummingbirds of species already mentioned, all of which were collected before 1:00 p.m. The values varied considerably. The total lipid in the body was 6.12±0.47 per cent (range, 3.33 to 11.39 per cent). Of this, 0.70±0.07 per cent, or a little more than one-tenth, was present in the liver, which averaged 3.68±0.25 per cent of the body weight. The liver lipid bore no relationship to the total body lipid. A low body lipid might be accompanied by a high liver lipid and *vice versa*: to illustrate, in two *Amazilia* one had 3.97 per cent body lipid and 7.62 per cent liver lipid while the other had 4.03 per cent body lipid and only 3.17 per cent liver lipid. Two hummingbirds with liver lipids of 9.23 and 8.72 per cent, respectively, contained 4.80 and 9.82 per cent body lipids.

Liver lipid in warblers.—The appearance of the livers of birds in families other than the Trochilidae indicated lower lipid content. We therefore chose to examine the livers of warblers because these birds are active and are largely insectivorous.

The liver lipid in 43 warblers distributed among eleven species is shown in figure 2. The livers of birds collected in the morning weighed less (*26 individuals, 3.63±0.095* per cent of the body weight) than those of birds collected in the afternoon (16 individuals, 4.35±0.098 per cent). The difference was highly significant ($p < .01$). The lipid content of the liver of those obtained in the morning was 0.28±0.013 per cent and of those obtained in the afternoon 0.54±0.029 per cent of the body weight, a highly sig-

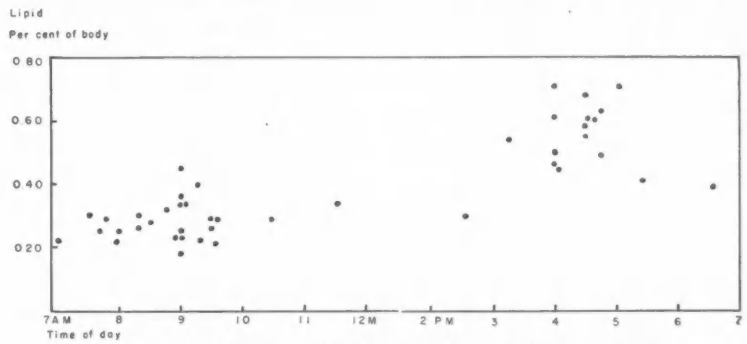

Fig. 2. Liver lipid as per cent of body weight in several species of warblers.

nificant difference ($p < .01$). The body weight of the warblers ranged from 7.3 to 19.2 grams, most of them being 9 grams or more. These values for liver fat are significantly lower than those in hummingbirds and the afternoon increase was less.

The liver and its lipid in other families.—The observations on warblers led us to examine the liver lipid content in birds of other families. The values are shown in table 2. The liver in per cent of body weight ranges from 1.23 to 5.10 but in many of them it ranges from 3 to a little more than 4 per cent. Few birds were collected in the afternoon but all that were, except the Catbirds (*Dumetella carolinensis*), showed an increase in liver lipid. The liver lipid for birds collected in the morning ranged from 0.12 to 0.35 per cent of the body weight, while the range in the afternoon was from 0.16 to 0.47 per cent.

The parakeets should be considered apart, since they were laboratory reared, indoors, from the time of hatching. They were also of the same strain from two nests and were four and six months old. Their food consisted of seeds with occasional leafy vegetables. It will be noted that the livers were small and that the liver lipid was very low.

Among these families we have chosen five which are largely insectivorous, namely, tyrant flycatchers, titmice, nuthatches, kinglets, and vireos, for a comparison of morning and afternoon liver lipids. In the morning, liver lipids formed 0.25±0.03 per cent and in the afternoon 0.38±0.045 per cent of the body weight. This difference, which is significant ($p < 0.05$), indicates a 50 per cent increase for the afternoon, but this is a smaller increase than was present in the warblers and it is a very much smaller increase than that found in hummingbirds. Comparison of the three groups, hummingbirds, wood warblers, and other insectivorous birds, is shown in table 3. It will be noted that the relative liver weights do not differ greatly while the liver lipid gain in the afternoon is much the greatest in the hummingbirds.

Thus, the lipid content of the liver of hummingbirds is higher at all times than that of other birds studied and it increases more in the afternoon than does that of other birds.

Table 2

Average Values for Liver Lipids in Other Families

Group	Body weight in grams	Liver weight as per cent of body weight	Liver lipid as per cent of body weight	
			a.m.	p.m.
Woodpeckers	(2) 46; 66	(2) 1.78; 4.57	(2) 0.22; 0.13	
Tyrant flycatchers	(4) 9; 10; 21.4; 21.5	(4) 3.22±0.18	(3) 0.24±0.018	(1) 0.39
Titmice	(8) 11.1±0.21	(8) 3.13±0.19	(7) 0.25±0.013	(1) 0.37
Nuthatches	(3) 10.2±0.56 (5) 21.7±0.36	(8) 3.11±0.37	(5) 0.15±0.022	(3) 0.28±0.032
Kinglets	(3) 5.92±0.053	(3) 4.12±0.27	(3) 0.32±0.012	
Vireos	(3) 16.1±0.8	(3) 3.45±0.18	(2) 0.25; 0.26	(1) 0.47
Jays	(2) 89.8; 93.6	(2) 3.17; 1.89	(1) 0.12	(1) 0.16
Thrushes	(4) 34.4±1.40	(4) 3.77±0.11	(4) 0.26±0.032	
Catbirds[1]	(2) 36.8; 38.3	(2) 5.10; 4.40	(1) 0.35	(1) 0.33
Sparrows[2]	(3) 18.4±0.37	(3) 3.58±0.19	(3) 0.23±0	
Parrots[3]	(8) 33.7±0.53	(8) 1.23±1.01	(8) 0.063±0.003	

[1] *Dumetella carolinensis*; [2] *Melospiza georgiana*; [3] *Melopsittacus undulatus*.

Table 3

Comparison of Values for Liver and Liver Lipids

	Range in body weight in grams	Liver as per cent of body weight (average)		Liver lipid as per cent of body weight (average)		Per cent increase in p.m.
		a.m.	p.m.	a.m.	p.m.	
Hummingbirds	3–10	(23) 3.35±0.14	(25) 3.88±0.16	0.37±0.030	0.87±0.050	135
Wood warblers	7–10	(26) 3.63±0.095	(16) 4.35±0.098	0.28±0.13	0.54±0.029	93
Other insectivorous birds	6–16	(20) 3.28±0.25	(6) 3.23±0.22	0.25±0.03	0.38±0.045	52

DISCUSSION

In our observations, differences in sex or time of collection did not affect liver weights. Riddle (1928), who worked with specimens of the same strain of Ring Dove (*Streptopelia risoria*) under controlled conditions, found that liver weights were greater in the female than in the male. We used a small number of specimens, many of which are undoubtedly of different genetic constitution. If we compare all species of hummingbirds, the difference between the morning and afternoon values is significant. A greater number of determinations might have increased the significance. Fisher and Bartlett (1957) found a decrease in liver weight overnight in both Redwinged Blackbirds (*Agelaius phoeniceus*) and Starlings (*Sturnus vulgaris*).

In regard to the liver lipid in hummingbirds a few aberrant values make the range great, but despite this there is no general change during the morning until 11 a.m. After this, there is a very definite increase continuing through 5 p.m. when the last values were obtained. This holds as well for individual species except in *Selasphorus scintilla* where the value was as high in the morning as in the afternoon. We are unable to suggest any reason for this sustained high value in this species unless it is a result of altitude.

Liver lipid, essentially fat, represents material mobilized from the storage depots or synthesized from food. In the morning much sugar is being ingested and by afternoon carbohydrate which has not been utilized to sustain the immediate activities of the bird

is being processed as fat. During the night the greatly reduced activity of the hummingbird in sleep or torpidity no doubt is accompanied by reduced processing and might account for the lipid fall. Pearson (1950) has shown that the metabolism of the torpid hummingbird may drop to as low as $\frac{1}{28}$ of the level of the daylight hours.

The amount of lipid in the liver accounts for a very small portion of the energy used in 24 hours. Pearson (1954) calculated that the energy exchange of a male Anna Hummingbird (*Calypte anna*) weighing 4 grams was 7.55 calories (assuming torpidity at night) or 10.32 calories (assuming sleep at night) for 24 hours. The average weight of the hummingbirds which were used in our work to calculate the difference in liver lipid content between the morning and afternoon was 5.29 grams. The difference between the liver lipid taken in the morning and afternoon was 0.50 per cent of the body weight (0.87–0.37); this would yield 0.25 cal. [0.50 per cent of 5.29 (average body weight) × 9.4 cal. (accepted value for 1 gram of fat)]. This could be used at night or shifted to the body stores. However, it is but a small portion of that needed since either 0.89 or 4.53 calories would be used at night if the situation were similar to that in Pearson's bird.

Fisher and Bartlett (1957) reported a decrease in both fat and glycogen stores in the liver overnight. However, the time permitted to elapse between the killing and freezing of the liver for glycogen determinations (one-half hour to one and one-half hours) would make the results questionable, as glycogen is broken down rapidly after death. The great range for glycogen values bears this out.

The greater amount of liver lipid at higher altitudes is noteworthy. It might be a reflection of the increased metabolism required because of the lower temperatures at high elevations.

All the hummingbirds in our study were tropical forms which apparently do not store as large a fat reserve as do species which migrate. The average total lipid in the body for 21 birds collected before noon at sea level was fairly low (6.12±0.47 per cent) while Norris, Connell, and Johnston (1957) found a range of 11 to 15 per cent in specimens of the Ruby-throated Hummingbird (*Archilochus colubris*) collected in June and a range of 41 to 46 per cent in pre-migratory individuals. Our highest value was 11.39 per cent. Odum and Connell (1956) reported that the total lipid in the body of the Ruby-throated Hummingbird averaged 13.4 per cent during the non-migratory period and 43 per cent just prior to migration. Musacchia (1953) obtained high lipid in the liver in Anseriformes and Charadriiformes in late summer during molting and the pre-migratory period.

Why are liver lipids of hummingbirds so high? Trochilids are not only the most active of birds but they are the smallest. Smaller birds present a greater surface exposure, and they require a higher rate of metabolism to maintain body temperature than do larger birds. Since diet may be a factor in the production of high liver lipid, we have also studied other small and fairly active birds, the wood warblers, which have a more uniform diet of insects. In this group the increase in liver weight in the afternoon over that in the morning was highly significant ($p < 0.01$), this increase being of greater significance than that in hummingbirds ($p < 0.05$). However, the liver lipid was lower and showed a relatively smaller increase in the afternoon in the warblers. Thus, the additional carbohydrate in the diet of hummingbirds may be a factor influencing the high lipid content of the liver.

It should be emphasized that other birds used in our study were collected during the pre-migratory period and are therefore perhaps not comparable with our hummingbirds which were all collected in the tropics and were non-migratory. Despite this, the difference in the liver lipid of the hummingbirds is striking.

If we compare the wood warblers with somewhat larger insectivorous birds we find

that the liver lipids of the former were higher in the afternoon ($p < 0.01$ than those of the larger birds, although in the morning, values of both groups were nearly the same.

The difference between the two groups of seedeaters (fringillids and psittacids) can be explained. The sparrows were living in a wild state and were pre-migratory while the parakeets were domesticated and non-migratory. This suggests that the increased processing of the food in the liver is accompanied by higher lipid content.

As we noted earlier, Odum and Perkinson (1951) found that the liver lipid bore a direct relationship to the total body lipid, that is, when the latter was low, as in the post-migration period, the liver lipid was also low, whereas during the pre-migration period, when body lipid was high, the liver lipid was also high. Their observations were on the White-crowned Sparrow (*Zonotrichia leucophrys*), a seedeater, whereas the hummingbird takes much sugar. The latter is processed more rapidly than are starches, fats, and proteins. This might account for the greater fluctuation in liver lipid. Thus the liver lipid might follow more closely the sugar intake.

We may conclude, tentatively, that the great difference in lipid content of the liver in hummingbirds as compared with other birds may be accounted for by the large amount of carbohydrate in their diet. Other birds studied were mostly insect eaters, a few being seedeaters. Small size is no doubt a factor, in causing high lipid values, but in addition muscular activity is important, the hummingbirds being one of the most active of all birds during their waking hours.

SUMMARY

Liver lipids were determined in 22 species of hummingbirds collected in Panamá. They were compared with those of members of other families collected in Maine. The livers of hummingbirds collected in the afternoon were possibly heavier than those obtained in the morning. The lipid values in these livers tended to be higher in the afternoon than in the morning. In sea level birds, the morning values were lower than the afternoon values. The morning values of the liver lipid of birds collected at 4500 feet above sea level were higher than morning values at sea level. The total lipid in the body was 6.12 ± 0.47 per cent whereas the liver lipid in these specimens was 0.70 ± 0.07 per cent.

In warblers the livers were heavier in the afternoon and contained more lipid than in the morning. The lipid content of the liver was lower than that in hummingbirds and the afternoon increase was less.

In other families the liver lipid was still lower. The relative liver weights of the different families of birds did not differ greatly except in domesticated parakeets in which both the liver and liver lipid were much the smallest.

The great difference in lipid content of the liver in hummingbirds as compared with other birds may be partly accounted for by the large amount of carbohydrate in the diet. The small size of the bird is no doubt a factor but in addition muscular activity is important.

LITERATURE CITED

Bloor, W. R.

1943. Biochemistry of the fatty acids and their compounds, the lipids (Reinhold, New York).

Fisher, H. I., and Bartlett, L. M.

1957. Diurnal cycles in liver weights in birds. Condor, 59:364–372.

Musacchia, X. J.

1953. A study of lipids in arctic migratory birds. Condor, 55:305–312.

Norris, R. A., Connell, C. E., and Johnston, D. W.

1957. Notes on fall plumages, weights and fat condition in the ruby-throated hummingbird. Wilson Bull., 69:155–163.

Odum, E. P., and Connell, C. E.
1956. Lipid levels in migrating birds. Science, 123:892–894.
Odum, E. P., and Perkinson, J. D., Jr.
1951. Relation of lipid metabolism to migration in birds: seasonal variation in body lipids of the migratory white-throated sparrow. Physiol. Zool., 24:216–230.
Pearson, O. P.
1950. The metabolism of hummingbirds. Condor, 52:145–152.
1954. The daily energy requirements of a wild Anna hummingbird. Condor, 56:317–322.
Riddle, O.
1928. Sex and seasonal differences in weight of liver and spleen. Proc. Soc. Exp. Biol. (New York), 25:474–476.

Department of Physiology, The Ohio State University, Columbus, Ohio, October 1, 1958.

NOTES ON THE OCCURRENCE OF BIRDS IN SOUTHERN NEVADA

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Southern Nevada is an arid, desert area, lying on the north edge of the Great American Desert and just south of the Great Basin. Its general elevation ranges from about 2000 to 4000 feet above sea level and slowly rises to the north toward the 5000 to 6000 foot elevation characteristic of the valleys of the Great Basin. On the south and east sides of southern Nevada is the Colorado River system, with its two large reservoirs, lakes Mead and Mohave. This river system flows in an canyon whose pre-dam floor was at about 500 to 600 feet above sea level. Rising from the desert floor are numerous mountain ranges. Most of these ranges seldom exceed an elevation of about 8000 feet, although the peak of the Charleston Mountains (Spring Mountain Range) reaches 11,910 feet elevation.

Vegetation types in southern Nevada range from the cottonwood-willow (*Populus-Salix*) association along the banks of the Colorado River to the white fir–bristle-cone pine (*Abies concolor-Pinus aristata*) belt high on Mount Charleston. However, most of the notes from which this paper was developed were obtained in the mesquite (*Prosopis juliflora*) bosques along the major drainage systems, in the farming areas of the Virgin, Moapa, Pahranagat, and Pahrump valley areas, or from the xeric desert shrub areas on the large alluvial fans between the desert ranges and the valley bottoms. The vegetation on these fans varies from a rather hostile creosote-bush—bur-sage (*Larrea tridentata-Franseria dumosa*) environment at lower elevations (2500 to 3500 feet elevation) to a somewhat more favorable and highly diversified mixed shrub environment on the higher slopes (3000 to 4500 feet elevation). Above this latter type, on the lower slopes of the desert mountain ranges, juniper forests (*Juniperus osteosperma*) abound. These in turn become increasingly dominated by piñon pine (*Pinus monophylla*) as the elevation exceeds 5000 feet.

The vegetation and animal life of this area is characteristic of a transition between two markedly different environments, and an interesting mixture of austral and boreal forms occurs, particularly insofar as the birdlife is concerned.

As is true of most of Nevada few human residents have shown an interest in the native non-game animal life and few records have been maintained. Most of the published information currently available has been the result of trips of short duration by persons from outside of the state. Notable among these have been the many collecting expeditions into Nevada by personnel from the Museum of Vertebrate Zoology at Berkeley, California.

However, southern Nevada has been more fortunate than the central and northeastern parts of the state. Personnel of the National Park Service, administering the Lake Mead Recreational Area, and personnel of the Fish and Wildlife Service on the Desert Game Range have been interested in the native fauna and have recorded much of what is presently in print concerning the animal life of this area. The notes published by Grater (1939*a*, *et seq.*) and Baldwin (1944, *et seq.*) for the most part were concerned with birdlife in the immediate vicinity of Lake Mead and the Colorado River, while Cottam's papers (1936, *et seq.*) concerned birds in the Pahranagat Valley and on the Fish and Wildlife Service installations in southern Nevada.

Van Rossem (1936) and Miller (1945) reported upon the avifauna of two unique and isolated, higher desert mountain ranges. Linsdale's two Nevada papers (1936 and 1951) largely represent a compilation of earlier papers and a review of museum specimens and field notes.

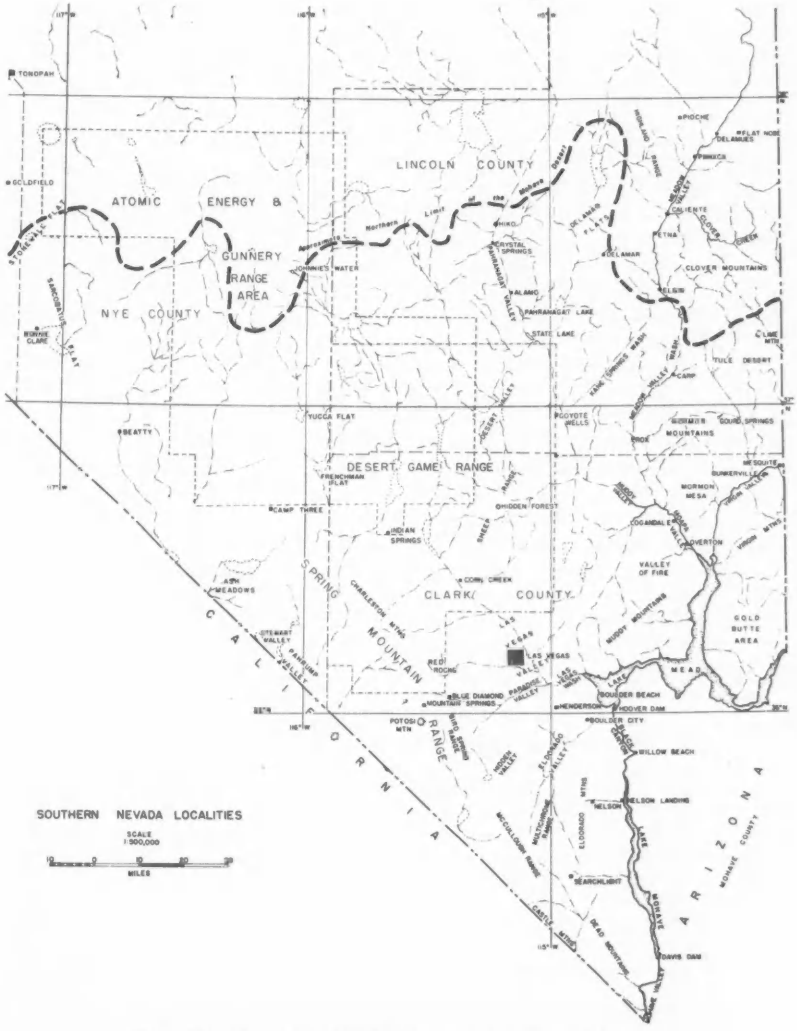

Fig. 1. Map of southern Nevada showing areas mentioned in text.

The notes presented in this paper are summarizations of observations made during yearlong wildlife studies in southern Nevada. For the most part they were made in desert areas which have not been extensively worked by earlier observers.

During the period from March, 1951, to October, 1954, a management-research project sponsored by the Federal Aid Division of the Nevada Fish and Game Commission gave Gullion an opportunity to make observations on the birdlife inhabiting the

rather restricted desert areas in which Gambel Quail (*Lophortyx gambelii*) is able to prosper (cf. Gullion, 1956:39–40). These areas include the brushy desert valleys and the mixed desert shrub lying at 3000 to about 4500 feet elevation.

Pulich was assigned to River Basin Studies, a branch of the United States Fish and Wildlife Service, during the period from October, 1948, to September, 1952. Most of his time was spent working the drainages of the Colorado River; hence his records represent areas infrequently visited by Gullion.

Although Evenden's assignment in the River Basin Studies concerned areas farther north in Nevada, he occasionally had reason to make short excursions into the desert habitats of southern Nevada.

While some of the annotation that follows represents additional records of rare species on the desert areas, the bulk of these notes concern the seasonal occurrence or distribution of birds in this area. This list does not constitute a complete list of the birds occurring on Nevada's southern deserts.

As noted earlier, this southern portion of Nevada for the most part constitutes the extent of the Mohave Desert in Nevada. However, as indicated by the heavy dashed line on the accompanying map (fig. 1), some of the northeastern areas included in this definition of southern Nevada are not typical of the Mohave Desert.

Figure 1 shows the location of the areas noted in this list, and, throughout the text, elevations above sea level are given for localities mentioned for the first time.

Nomenclature throughout this list follows that of the fifth edition of the American Ornithologists' Union Check-list of North American Birds (1957).

Appreciation is extended to Mrs. Nora Poyser of Boulder City, Nevada, to Tom Imhof of Atlanta, Georgia, and to Dr. Allan R. Phillips of Tucson, Arizona, for the privilege of including certain of their notes in this paper. Also, the assistance rendered by Dr. Alden H. Miller of the Museum of Vertebrate Zoology in the identification of several specimens is acknowledged.

Gavia immer. Common Loon. A partly decomposed specimen was found one mile north of Etna (4200 feet elevation, in Rainbow Canyon, Meadow Valley Wash, Lincoln County), on May 26, 1951; and one loon of this species was seen on the Pahranagat Valley lakes (3000 feet elevation, Lincoln County) on October 26 and November 16, 1951.

Aechmophorus occidentalis. Western Grebe. Imhof reported to Pulich the occurrence of this species at Yucca Flat (4150 feet elevation, Nye County) on October 26, 1951. The bird was "struggling for take-off" from a blacktop airstrip. Another record was obtained by Gullion for several birds on Pahranagat (Dike) Lake on the same date. Imhof reported one from Lake Mead (1200 feet elevation) on November 26, 1951, and two days later Pulich saw two on Lake Mohave (600 feet elevation), both in Clark County.

Pelecanus erythrorhynchos. White Pelican. Recorded from the Pahranagat Valley lakes on March 31, 1951 (one bird), May 14, 1952, and on August 10, 1954 (several birds) and from the Colorado River below Davis Dam (500 feet elevation, Mohave Valley, Clark County) on April 5, 1952 (large flock).

Phalacrocorax auritus. Double-crested Cormorant. A common permant resident on the lakes in the Pahranagat Valley and on the Colorado River and its reservoirs. In spite of efforts to destroy it, a nesting colony has persisted for several years in the cottonwood grove at the north end of Pahranagat Lake. Nestlings were present in this colony on May 23, 1951.

Butorides virescens. Green Heron. Two records: one bird seen in Mohave Valley on April 12, 1951, and another at a spring-hole just north of Panaca (4800 feet elevation, Meadow Valley, Lincoln County), August 8, 1952.

Casmerodius albus. Common Egret. Early spring arrivals seen in the Virgin Valley (1700 feet elevation, Clark County) on April 11, 1951. Although Linsdale (1936:31) cites a winter record for

the Colorado River in the Mohave Valley, this April date is our earliest record. This species remains in Mohave Valley as late as October 23 (1951).

Leucophoyx thula. Snowy Egret. Recorded from wet areas in most valleys and on the shores of lakes Mead and Mohave. Early spring arrivals appear about April 28 (1951). Two unusual records: one bird on the Boulder Dry Lake (1700 feet elevation, Eldorado Valley, Clark County), May 3, 1951, and two birds on Sarcobatus Flat (4000 feet elevation, Nye County), at least 26 miles from the nearest pools of water at Springdale (3800 feet elevation, Nye County), May 28, 1953.

Nycticorax nycticorax. Black-crowned Night Heron. Although a fairly common permanent resident in brushy riparian sites along the Colorado River, in Pahrump Valley (2800 feet elevation, Nye County) and along the Meadow Valley Wash and in Pahranagat Valley, one unusual record was that of a single individual seen at about 2500 feet elevation in the creosote bush—bur-sage vegetation type on the Quo Vadis slope north of Boulder Dry Lake. This bird was 13 airline miles from the nearest riparian or marsh habitat.

Plegadis chihi. White-faced Ibis. Recorded from the Pahrump Valley, August 5, 1953, two birds; Ash Meadows (2250 feet elevation, Nye County), August 6, 1954, one bird; and Pahranagat Lake, August 10, 1954, one bird.

Olor columbianus. Whistling Swan. Two birds were seen by Pulich during an aerial waterfowl survey on Pahranagat Lake, January 7, 1952.

Branta canadensis. Canada Goose. A winter visitor, *B. c. moffitti* moves into this area as early as October 23 (1951, Mohave Valley) and remains in some abundance in the Mohave, Virgin, Moapa (1300 feet elevation, Clark County) and Pahranagat valleys until as late as March 31 (1949 and 1951). Two birds taken by hunters on November 4, 1951, near Bunkerville (1650 feet elevation, Virgin Valley, Clark County) were banded at Blackfoot Reservoir, Carabou County, Idaho, as adults. One was banded in June, 1947, and the other in June, 1951.

B. c. leucopareia, the "Lesser Canada Goose," was identified among flocks of *B. c. moffitti* seen in the Virgin Valley on November 4 and 23, 1951.

A single *B. c. minima,* the "Cackling Goose," was seen in a flock of the larger races along the Virgin River west of Bunkerville on November 4, 1951. Other birds of this race were seen at Overton (1300 feet elevation, Moapa Valley) on February 28, 1952.

Chen hyperborea. Snow Goose. Recorded from the Pahranagat Valley on March 31 and October 26, 1951, and from the Mohave Valley on October 23, 1951; large flocks of northward bound migrants were observed passing over the Gold Butte area (2400 feet elevation), southeast of Overton, on February 25 and March 2, 1953.

Anas platyrhynchos. Mallard. Recorded on ponds and streams throughout the area from September to May, but the species leaves the hotter areas for the summer, remaining to breed in the Pahranagat and Meadow valleys (4800 feet elevation, Lincoln County), at least in small numbers.

Anas strepera. Gadwall. An uncommon winter visitor, recorded from ponds and streams throughout the area from as early as August 7 (1952) to as late as May 26 (1951). Recorded localities include Meadow, Pahranagat and Pahrump valleys, Ash Meadows and Mead and Mohave lakes.

Anas acuta. Pintail. Recorded from all of the wet, valley areas, from as early as August 7 (1953, Pahranagat Valley) to as late as May 26 (1951, Meadow Valley).

Anas carolinensis. Green-winged Teal. One winter record from Lake Mohave, January 7, 1952; and several spring records from February 9 (1954, Overton) to May 14 (1952, Pahranagat Valley). One fall record: Imhof reported a single bird, October 26, 1951, at Yucca Flat, on the wet "dry" lake following a rainstorm.

Anas discors. Blue-winged Teal. Noted in the Pahranagat Valley on May 8 and 14, 1952.

Spatula clypeata. Shoveler. Recorded in the Pahranagat and Virgin valleys from as early as August 9 (1951) to as late as March 31 (1951).

Aythya americana. Redhead. Winter visitor, particularly in the Pahranagat Valley, from at least August 10 (1954) to May 23 (1951). Also recorded in the Virgin Valley, November 5, 1951, and at Lake Mohave, January 7, 1952.

Aythya collaris. Ring-necked Duck. Five records: Pahranagat Valley, March 31, 1951, 30 birds; Pahrump Valley, May 20, 1951, one bird; Willow Beach (600 feet elevation, three birds seen on the interstate waters of Lake Mohave from the Mohave County, Arizona, side), November 26, 1951; and again on Lake Mohave on January 7 (one bird) and 16, 1952.

Aythya valisineria. Canvasback. Three records: Overton, February 13, 1951, one bird; Pahranagat Valley, March 31, 1951, about 15 birds; and Lake Mohave, January 7, 1952, one bird.

Bucephala clangula. Common Goldeneye. On February 13, 1951, one was seen at Overton. On March 27, 1951, a flock of goldeneyes seen flying over Las Vegas Valley (1800 feet elevation, Clark County) was believed to be of this species, and four days later, March 31, about eight birds of this species were seen on lakes in the Pahranagat Valley. Imhof observed three birds on Lake Mead on November 26, 1951.

Bucephala albeola. Bufflehead. Recorded from as early as November 28 (1951, Lake Mohave) to as late as May 14 (1952, Pahranagat Valley).

Oxyura jamaicensis. Ruddy Duck. Recorded as present on southern Nevada waters from August 30 to as late as May 23 (both in 1951 in Pahranagat Valley). Also noted frequently in the Virgin and Moapa valleys and on Lake Mohave. Imhof observed two on the wet Yucca Flat dry lake on October 26, 1951, following a rainy spell.

Lophodytes cucullatus. Hooded Merganser. One record: Pulich observed two on Lake Mohave below Hoover Dam, January 16, 1952. This appears to be the first record for this species in southern Nevada.

Mergus serrator. Red-breasted Merganser. Three records: Imhof observed this species on Lake Mead, November 26, 1951. On May 23, 1952, a bird was found dead on U. S. Highway 95 (at 2500 feet elevation) about 19 miles south of Searchlight (3600 feet elevation, Clark County); and on June 3, 1952, a road-killed male was examined on the same highway where it crosses the Boulder Dry Lake in Eldorado Valley (1700 feet elevation).

Cathartes aura. Turkey Vulture. These birds are primarily spring and fall migrants on the desert, with most records falling between March 9 (1951, Overton) and late June, and again in September. Conspicuous migratory flights occur in April. We have three midsummer records from the desert: Las Vegas Valley, July 14, 1951, four birds; Mohave Valley, July 19, 1951, about 15 birds; and two birds over Lake Mead on July 26 and 27, 1952. One bird over the Mohave Valley on January 25, 1952, constitutes the single winter record for this species in Nevada.

Accipiter striatus. Sharp-shinned Hawk. Common on the desert only in fall and spring migration. Fall migration extends from mid-October to late November, and spring migration is primarily in April, although records as early as February 2 (1952, Las Vegas Valley) have been obtained. One bird collected by Gullion in Las Vegas Valley, four miles east of Las Vegas, on April 10, 1952, has been identified at the Museum of Vertebrate Zoology as *A. s. velox* (no. 125707, Mus. Vert. Zool.).

Accipiter cooperii. Cooper Hawk. Absent from the desert in the summer; these hawks arrive from the north as early as August 6 (1953, Pahrump Valley) and remain through the winter until as late as May 20 (1951, also in Pahrump Valley). During heavy fall migration, from about mid-September to early October, and again in spring migration during April, this species, together with the Sharp-shinned Hawk, became so numerous that Gullion had to suspend quail trapping to prevent heavy game-bird losses.

Buteo jamaicensis. Red-tailed Hawk. Although a common fall and spring migrant, the Redtails become appreciably scarcer in July and in the winter period. However, we have several winter records as follows: one bird, December 18, 1951, Dead Mountains (Clark County); one bird, January 16, 1952, over Lake Mohave; January 25, 1951, in Mohave Valley; one bird, January 27, 1952, at Boulder Beach, Lake Mead (1200 feet elevation, Clark County); February 2 (one bird) and 18 (two birds), 1952, in the Valley of Fire (1900 feet elevation, Clark County); one bird, February 22, 1952, at Nelson (3400 feet elevation, Clark County); and one bird, March 10, 1951, Gold Butte area. On May 3, 1951, Pulich banded two nestlings in Poachers Wash (1880 feet elevation), in the Dead Mountains just west of Mohave Valley.

Buteo swainsoni. Swainson Hawk. A common spring and fall migrant on the desert, occurring in the spring from as early as February 6 (1953, Searchlight) to June 21 (1952, Eldorado Mountains, 4000 feet elevation, near Nelson), and in the fall from as early as August 7 (1954, Kane Springs Wash, 3000 feet elevation, Lincoln County) to as late as September 27 (1954, Gold Butte). However, this species also occurs sparingly in summer since Johnson and Richardson (1952:358) obtained nesting records in June, 1951, in the Pahrump Valley and Ash Meadows, and Evenden observed nesting in progress on May 14, 1952, in the Pahranagat Valley near Alamo (3400 feet elevation).

Buteo regalis. Ferruginous Hawk. Two records: one on October 22, 1949, in Las Vegas Valley between Henderson (1790 feet elevation) and Las Vegas, and a road-killed male recovered from the highway in Pahranagat Valley by Gullion on November 16, 1951 (no. 125708, Mus. Vert. Zool.).

Aquila chrysaëtos. Golden Eagle. These birds occur sparingly over all parts of the desert from as early as August 7 (1954, Mormon Mountains, Lincoln County) to as late as June 27 (1954, in the same area). Two immature birds on July 9, 1952, in the Gold Butte area constitute the single summer record for the desert, although van Rossem (1936:20–21) cites July records for the Charleston Mountains, Clark County.

Circus cyaneus. Marsh Hawk. Contrary to the statement by Linsdale (1951:232), this species is not "closely restricted to wet meadows and marsh ground" during its occurrence on the southern Nevada deserts. Marsh Hawks are widespread on the desert areas from about September 4 (1953, Gold Butte) to as late as April 8 (1952, Las Vegas Valley). They linger somewhat longer in the more moist desert valleys, remaining as late as May 26 (1951, Meadow Valley) and returning as early as August 6, 1954, Pahrump Valley).

Pandion haliaetus. Osprey. Four more Colorado River records: one bird at Davis Dam on October 23, 1951; one in Mohave Valley, November 30, 1951; and one in Black Canyon, Lake Mohave on January 7 and 16, 1952. Also we have two records away from the river: Imhof observed one flying south over Frenchman Flats (3100 feet elevation, Nye County) on November 12, 1951; and one was seen at Boulder City (2450 feet elevation, Clark County) on August 30, 1952.

Falco mexicanus. Prairie Falcon. Most of the southern Nevada desert records are for spring, extending from February 17 (1953, Gold Butte) to May 23 (1951, Pahranagat Valley). There are three summer records: July 3, 1951, in Las Vegas Valley; July 8, 1952, in the Gold Butte area; and August 30, 1951, in the Pahranagat Valley. Van Rossem (1936:21) cites October records for the Charleston Mountains and Indian Springs (3100 feet elevation, Clark County), and we have one winter record of one bird a few miles south of Boulder City, on January 6, 1950.

Falco peregrinus. Peregrine Falcon. Four records of single birds from southern Nevada desert valleys: Pahrump Valley, August 25, 1951; Flat Nose Ranch (5250 feet elevation, 12 miles east-southeast of Pioche, Lincoln County), September 27, 1951; State Lake, Pahranagat Valley, August 10, 1954; and one seen by Imhof near Johnnies Water (6650 feet elevation, Belted Range, Nye County) on November 28, 1951.

Falco columbarius. Pigeon Hawk. Three records of one bird each: Pahranagat Valley, October 27, 1951; the Virgin Mesa (1750 feet elevation, on the west slopes of the Virgin Mountains, Clark County), April 17, 1953; and seen by Imhof at Frenchman Flat, October 3, 1951.

Falco sparverius. Sparrow Hawk. Desert records primarily in the spring months, from March 22 (1952, Searchlight area) to mid-July. Fall records are most numerous from August 5 (1953 and 1954, Pahrump Valley) to about September 26 (1954, Gold Butte area), with one late fall record, November 28, 1953, from Gold Butte.

Lophortyx californicus. California Quail. On February 7, 1954, 114 birds of this species were released in the Clover Creek Valley, about three miles east of Caliente (4500 feet elevation, Lincoln County). Although these birds have dispersed as far as Delamue's (19 miles north), where a banded bird was taken in November, 1954, the success of this release is still uncertain.

Perdix perdix. Gray Partridge. Records maintained by the Clark County Game Management Board show that about 200 birds of this species were released in Clark County (site not specified) during the early 1930's. This plant apparently failed since there have been no subsequent reports of this species in southern Nevada.

Alectoris graeca. Chukar Partridge. Sparingly established in at least four locations in southern Nevada. A population became initially established in the Virgin Mountains as the result of a release of 25 birds at Sheep Spring (4200 feet elevation) on June 15, 1953. Several substantial subsequent releases (about 600 birds in all) were made to speed the development of this population. Other populations occur in the Cottonwood Canyon area (3800 feet elevation, Clover Mountains, 7 miles east of Elgin), at the Flat Nose Ranch, and near the Comet Mine, 6480 feet elevation, on the west side of the Highland Range, Lincoln County (Gullion and Christensen, 1957:133).

A number of earlier releases by sportsmen's groups in more typically desert environments failed. Christensen (1954:16) shows the release of 195 birds at various Clark County locations such as Potosi Mountain, Gold Butte, Red Rock Spring (4400 feet elevation, Red Rock area, 18 miles west of

Las Vegas, Clark County), Knob Hill (4300 feet elevation, Eldorado Mountains, near Nelson), and Callville Wash (1500 feet elevation, north shore of Lake Mead, Clark County). In addition more than 270 chukars have been released in desert habitats by Nye and Lincoln county sportsmen's groups without success.

Fifty-four birds of the race *A. g. cypriotes*, the so-called Turkish Chukar, were released in Meadow Valley Wash a few miles south of Caliente on March 17, 1955. The success of this release is still not certain.

Porzana carolina. Sora. Birds were noted in Las Vegas Wash (1500 feet elevation, Clark County) on September 29 (nine or more) and November 3, 1951, and on April 5, 1952; one bird was noted southwest of Panaca on May 14, 1952. On May 17, 1953, a bird captured in Meadow Valley was turned over to Nevada Fish and Game Commission personnel at Las Vegas.

Charadrius vociferus. Killdeer. Most common as a spring and fall migrant wherever water occurs on the desert. Spring records extend from February 12 (1954, Meadow Valley) to June 3 (1952, Las Vegas Valley), and fall records run from August 5 (1953 and 1954, Pahrump Valley) to November 16 (1951, Pahranagat Valley). Van Rossem (1936:22) cites July records for Indian Springs and the Charleston Mountains.

Capella gallinago. Common Snipe. Records from desert areas include the following: Boulder City, March 8, 1950 (Pulich's lawn); Las Vegas Wash, March 1, 1951; Boulder City, September 11, 1951 (Gullion's lawn); Virgin Valley, November 5, 1951; and a fresh road kill in the Logandale area (1800 feet elevation, Moapa Valley, Clark County) found on November 13, 1951.

Actitis macularia. Spotted Sandpiper. May and August migrant through the desert. Spring dates fall between April 28 (1951, Las Vegas Wash) and May 26 (1951, Meadow Valley), and fall dates extend from July 19 (1951, along the Colorado River in Mohave Valley) to August 29 (1951, Meadow Valley Wash south of Rox, 2000 feet elevation, Lincoln County). Van Rossem (1936:22) cites July records for the Charleston Mountains and September records for Indian Springs.

Tringa solitaria. Solitary Sandpiper. Two records: four birds, Pahrump Valley, August 5, 1953; and "several" birds, Pahranagat Lake, August 18, 1954.

Catoptrophorus semipalmatus. Wilet. Two records: one bird, Pahrump Valley, August 25, 1951; and Lake Mead, August 2, 1951, about 100 birds (reported to Pulich by National Park Service personnel).

Totanus melanoleucus. Greater Yellowlegs. A rare spring and fall migrant at desert waterholes and ponds. Three spring records fall between March 21 (1952, Las Vegas Valley) and April 7 (1952, Boulder Dry Lake), and four fall records extend from August 4 (1953, along the Colorado River in Mohave Valley) to September 24 (1954, Overton area).

Totanus flavipes. Lesser Yellowlegs. One record: one bird on a lawn being watered with a sprinkler at Desert Game Range Headquarters, Corn Creek (2900 feet elevation, Clark County), on July 30, 1951.

Limnodromus scolopaceus. Long-billed Dowitcher. Three records: nine birds, Las Vegas Valley, March 26, 1951; many birds, Pahranagat Valley, October 26, 1951; and one bird on the shoreline of Lake Mead near Overton, August 12, 1953.

Ereunetes mauri. Western Sandpiper. One spring record: one bird, Las Vegas Valley, April 30, 1951. Four fall records, from August 8 (1953, Meadow Valley) to August 18 (1954, Pahranagat Valley).

Limosa fedoa. Marbled Godwit. Two records: Pahranagat Lake, August 18, 1954, seven birds on a mud flat; and Boulder Dry Lake (with water in it), Eldorado Valley, one bird on September 11, 1957.

Himantopus mexicanus. Black-necked Stilt. Two records: 13 birds, Pahranagat Valley, May 23, 1951; and one bird, Pahrump Valley, August 6, 1953.

Steganopus tricolor. Wilson Phalarope. One spring record, one bird, Pahrump Valley, May 20, 1951; and four fall records, from August 4 (1954, Mohave Valley) to August 30 (1951, Pahranagat Valley).

Larus delawarensis. Ring-billed Gull. Two records away from lakes Mead and Mohave (where of regular occurrence): about 40 birds on March 31 and three birds on May 23, 1951, in the Pahranagat Valley.

Chlidonias niger. Black Tern. Two records: 8 to 10 birds in migration over Stonewall Flat (4500 feet elevation, Esmeralda County), August 4, 1951; one bird, Pahranagat Valley, August 18, 1954.

Zenaida asiatica. White-winged Dove. This dove is a common summer resident in the hot, humid bottomlands of the Mohave Valley. The earliest spring record is the May 9 (1934) date given by Linsdale (1936:61), while our earliest date is May 14 (1951). These doves remain in this area until at least as late as August 4 (1954) and probably later, for Pulich found a nest containing two eggs at Fort Mohave (540 feet elevation), on the Arizona side of Mohave Valley, on August 3, 1950. Other records include Hyco Springs (1880 feet elevation), May 23, 1953, and Grapevine Springs (2360 feet elevation), August 4, 1954, both sites on the east slope of the Dead Mountains; and Overton, on June 13, 1953, and August 3, 1954.

This species appears to be expanding its range in southern Nevada, having been seen frequently in the Moapa Valley in the vicinity of Overton in the summer of 1954. Mrs. Poyser observed three Whitewings in the Pahranagat Valley on July 16, 1953 (Monson, 1953*b*:321), and this species was reported from the Pahrump Valley earlier (Johnson and Richardson, 1952:358).

Zenaidura macroura. Mourning Dove. Although listed as a permanent resident by Linsdale (1951:235), we have no winter records on the desert. The earliest spring record is for March 9 (1953), and our latest fall record is for November 11 (1951), both in the Las Vegas area. Nesting is under way by mid-May and extends into August. The numbers of these doves on the desert varies greatly from year to year. In 1952, when food conditions were exceptionally favorable (cf. Gullion, 1956:34–35) doves were abundant nesters on all parts of the desert until the end of June. In other years nesting is mostly restricted to valley areas.

Coccyzus americanus. Yellow-billed Cuckoo. Two records of single birds: Boulder City, May 23, 1950; Mohave Valley, August 14, 1952.

Geococcyx californianus. Roadrunner. Although apparently a permanent resident of all southern Nevada desert areas, this bird is most abundant in the valley areas. The northernmost record in Nevada is of a bird seen near Panaca on August 9, 1951. The curious courting antics of this bird are under way by mid-March, and a nest with newly hatched chicks and some eggs was found in a cholla (*Opuntia bigelovii*), at about 1700 feet elevation on the southeast slope of the Dead Mountains on June 7, 1952.

Tyto alba. Barn Owl. Three records: one bird, Searchlight area, August 17, 1951; one bird, Dead Mountains (3200 feet elevation, at the head of Empire Wash), July 11, 1952; and one bird in the Gold Butte area, September 20, 1954.

Otus asio. Screech Owl. Six records: one heard the night of September 28, 1951, at the Flat Nose Ranch; several collected by Phillips and Pulich in Mohave Valley on October 1, 1951; a fresh road kill picked up by Gullion in Mesquite (1800 feet elevation, Virgin Valley, Clark County) on November 11, 1951 (no. 125714, Mus. Vert. Zool.); one collected by Pulich in Mohave Valley on August 14, 1952; one collected by Gullion at Catclaw Spring (2300 feet elevation), Gold Butte area, February 17, 1953 (skin later destroyed by a wood rat); and one bird heard in Cedar Basin (4400 feet elevation), Gold Butte area, September 30, 1954. A. R. Phillips identified the Mohave Valley birds as being *O. a. yumanensis*, while A. H. Miller identified the Mesquite bird as belonging to the race *O. a. cineraceus*.

Bubo virginianus. Great Horned Owl. Linsdale (1951:236) lists this species only from the Charleston Mountains and along the Colorado River. Additional records have been obtained in Pahrump Valley, May 20, 1951; Eldorado Mountains, June 3, 1952; Dead Mountains, July 2, 1952, and March 3, 1954; Gold Butte area, September 3, 1951, March 30 and April 1, 1953, September 23 to 30, 1954; and the Flat Nose Ranch, September 28, 1951.

Speotyto cunicularia. Burrowing Owl. Seven records: a nesting burrow regularly occupied was examined near Cataract Spring (2480 feet elevation), Gold Butte area, March 9, 1951; a considerable number of birds was flushed from a roadway in the Dead Mountains on the evenings of July 2 and 11, 1952; a single bird caught in a quail trap and banded, Las Vegas Valley, November 27, 1952; a single bird on the Manse Ranch (2770 feet elevation, Pahrump Valley), August 5, 1954; and Imhof saw this species at Frenchman Flat, October 3, 1951, and at Bonnie Clare (3950 feet elevation, Nye County), October 7, 1951.

Asio otus. Long-eared Owl. A permanent resident in the Las Vegas Valley, with fledglings noted there on May 23, 1952.

Phalaenoptilus nuttallii. Poor-will. Summer resident on all desert ranges (possibly a permanent resident), becoming common in April and remaining so until the end of August. Stragglers were noted in the Gold Butte area on October 11 and 12, 1951, and in the Virgin Mountains on November 23, 1953. Two winter records: one bird, Quo Vadis area (2400 feet elevation, 5 miles south of Henderson, Clark County), January 24, 1952; and one bird in the Gold Butte area, February 25, 1953. A nest containing a single egg was found at about 5000 feet elevation on the northeast side of Potosi Mountain, Clark County, April 24, 1952.

Chordeiles acutipennis. Lesser Nighthawk. Common summer resident in all desert valley areas. Earliest spring arrivals were recorded on April 10 for three consecutive years, at Las Vegas in 1951, Boulder City in 1952, and Overton in 1953. Most of the birds have departed by mid-August, but one late record, on October 31, 1953, was obtained in Las Vegas Valley.

During the hotter summer days, when the air temperatures exceed 108° to 110°F. in the Las Vegas Valley, these birds leave their daytime roosts and course lazily back and forth, low over the mesquite bosques. These are apparently not foraging flights, but simply cooling efforts. As the heat diminishes later in the day the nighthawks disappear into the dense thickets, where they roost until their feeding forays commence at dusk.

Chaetura vauxi. Vaux Swift. Five May records (all migration dates): in 1951, May 8 in Las Vegas Valley, May 3 and 14 in the Mohave Valley area, May 23 in the Pahranagat Valley; and in 1953, May 3, at Willow Beach, Lake Mohave (over interstate waters).

Aeronautes saxatalis. White-throated Swift. Common summer resident in the rougher desert mountain ranges, tending to wander widely over the desert (as singles and flocks) after the nesting season. Our earliest spring arrival date is February 27 (1954, Overton area), although most of the birds do not arrive until April. Our latest fall record is September 28 (1954, Gold Butte area).

Archilochus alexandri. Black-chinned Hummingbird. One record: a single male in Mohave Valley opposite Fort Mohave, May 2, 1952.

Calypte costae. Costa Hummingbird. Records only for the spring period. Perhaps the birds move farther north as the summer heat increases and flowers wither. The earliest recent record is by Mrs. Poyser from Boulder Beach, February 24 (1952); the latest, June 28 (1954), from the Mormon Mountains. Linsdale (1936:67) records birds taken on February 13, 1934, in the Dead Mountain–Mohave Valley area.

Selasphorus platycercus. Broad-tailed Hummingbird. Two records: at least six migrant birds at Gourd Springs (3800 feet elevation, Mormon Mountains, 14 miles southeast of Carp, Lincoln County) on September 1, 1951. National Park Service personnel reported to Pulich having seen a bird in Boulder City on August 31, 1951.

Selasphorus rufus. Rufous Hummingbird. Three fall records: three birds seen at Big Pine Spring (5500 feet elevation, McCullough Range, 16 miles northwest of Searchlight), August 21, 1951; one bird at McCullough Spring (4100 feet elevation, McCullough Range), August 22, 1951; and one bird at Mule Springs (4890 feet elevation, 4 miles west of Mountain Springs, Clark County), August 24, 1951.

Megaceryle alcyon. Belted Kingfisher. Three records: one bird, Pahranagat Valley, May 24, 1951; one bird, Overton, September 5, 1951; and one bird in the Panaca area in Meadow Valley, August 11, 1954.

Colaptes cafer. Red-shafted Flicker. A winter visitor on the desert, arriving about September 20 (1954, Gold Butte area) and remaining as late as May 14 (1951, Mohave Valley). Summer records are mostly for higher or more northerly areas, although a record for July 1, 1954, was obtained for one bird in a Joshua tree (*Yucca brevifolia*) forest on the south end of the Multichrome Range northwest of Searchlight.

Centurus uropygialis. Gila Woodpecker. Three records: Mohave Valley, August 15, 1951, and January 25, 1952; and one bird in Las Vegas Valley, March 15, 1953.

Asyndesmus lewis. Lewis Woodpecker. Three spring records on the desert: one bird found dead in Boulder City, March 21, 1951; one bird in Pahrump Valley, May 20, 1951; and one bird in the Eldorado Mountains near Nelson, May 5, 1953. All previously published records for Nevada's deserts have been for dates from September to November.

Dendrocopos villosus. Hairy Woodpecker. Three additional records: one bird seen at Indian Spring and one in Cabin Spring Canyon (both at about 4500 feet elevation), on the north slope of the

Virgin Mountains, 8 miles south of Mesquite, November 27, 1953; Imhof reports one in the Charleston Mountains (at 7500 feet elevation) south of Indian Springs on October 6, 1951.

Dendrocopos pubescens. Downy Woodpecker. One bird was seen in the mesquite bosque (1800 feet elevation) in Las Vegas Valley about 4 miles east of Las Vegas on March 17, 1951. This is the first record for this species in southern Nevada.

Dendrocopos scalaris. Ladder-backed Woodpecker. Common permanent resident on the desert ranges, especially in mesquite thickets and Joshua tree forests. Records from the head of Pennsylvania Wash (6500 feet elevation) in the Clover Mountains, 8 miles northeast of Elgin, on August 31, 1951, and from the Garden Spring area (4500 feet elevation) on the north edge of the Tule Desert, 15 miles southeast of Elgin, on June 26, 1954, as well as the recent record for the Hiko area (4100 feet elevation, Lincoln County) by Johnson (1956:450), indicate that these birds range to the northern limits of the Mohave Desert in Nevada.

Tyrannus verticalis. Western Kingbird. As stated by Linsdale (1951:238) this bird occurs commonly in the moist valley areas; it also occurs on the desert ranges, particularly in the vicinity of human habitation. Normal arrival dates fall in late March or early April (March 31, 1951, at Alamo, and April 8, 1952, near Las Vegas). Our latest fall record is September 5 (1951, Lake Mead), but most of the birds have departed by the end of August. Nesting extends from about May 19 to at least July 19.

Myiarchus tyrannulus. Crested Flycatcher. One additional record: a single bird seen in a mesquite bosque in Ash Meadows, on August 25, 1951. This apparently constitutes the second record for this species in Nevada, and the first outside of the Colorado River drainage system (cf. Pulich, 1952).

Myiarchus cinerascens. Ash-throated Flycatcher. Spreading over the desert in early April (April 2, 1953, Gold Butte area), this bird is one of the few species common on all parts of the desert all summer. A record for September 5, 1951, from the Muddy Mountains, Clark County, is our latest fall record on the desert ranges. One additional winter record; one bird, Mohave Valley, January 25, 1952.

Sayornis nigricans. Black Phoebe. Probably an uncommon permanent resident, with records available for all seasons: Pahrump Valley, May 20, 1951; Highland Spring (4400 feet elevation, Multichrome Range), August 21, 1951; McCullough Spring, August 22, 1951; Davis Dam area, October 23, 1951; Virgin Valley, November 5, 1951; Boulder City, February 28, May 23, and August 4, 1952; Searchlight, June 4, 1952; Mohave Valley, August 4, 1953; Overton, August 7, 1953; Crystal Springs (3900 feet elevation, 4 miles south of Hiko), Pahranagat Valley, August 7, 1953; Boulder Beach, Lake Mead, January 26 and 27, 1952; Las Vegas Wash, August 11 and November 3, 1951, and March 1, 1952; and near Panaca, May 14, 1952.

Sayornis saya. Say Phoebe. We have several winter records outside of the lower Colorado River area (cf. Linsdale, 1951:238), as follows: Boulder City, December 21, 1949; Boulder Beach, January 20, 1951; Las Vegas Valley, January 24, 1952; Valley of Fire, February 2, 1952; and west of Emerson Spring (1600 feet elevation), Muddy Mountains, February 28, 1954. Nest building was begun at Boulder Beach on February 22, 1952, with eggs by March 1. Other nesting records include eggs on April 12, 1951, in the Virgin Mountains, April 26, 1952, in the Dead Mountains, and near Nelson on May 3, 1951; and nestlings in the Dead Mountains on May 7, 1951, and in Meadow Valley on May 26, 1951.

Nuttallornis borealis. Olive-sided Flycatcher. Four records: two birds, Mohave Valley, May 3, 1951; one bird, Pahrump Valley, May 19, 1951; and one bird, Ash Meadows, May 20, 1951, all in mesquite habitats; and one bird, Deer Creek, 9000 feet elevation, Charleston Mountains, August 9, 1952.

Pyrocephalus rubinus. Vermilion Flycatcher. Permanent resident, regularly recorded from Paradise Valley south of Las Vegas, Pahrump Valley, Moapa Valley, and as far north as Crystal Springs in Pahranagat Valley on August 7, 1953. Mrs. Poyser saw a single male at Boulder Beach on February 28, 1951, during a snowstorm.

Eremophila alpestris. Horned Lark. Common winter visitors and less common, but widespread, summer residents. Summer records are from these areas: Mormon Mountains, August 10, 1951, June 28, 1952, June 25, 1953, June 23 and 25, 1954; Desert Valley (4000 feet elevation, Lincoln County), June 27, 1951; Kane Springs Wash, August 30, 1951; Pahranagat Valley, June 28, 1952; Las Vegas Valley, June 28, 1952, and August 6, 1954; Pahrump Valley, August 5 and 6, 1953, and August 6, 1954; Hidden Valley (3800 feet elevation, 22 miles south of Las Vegas, Clark County),

June 29, 1954; and Tule Desert (3500–4000 feet elevation, Lincoln County), June 26 and 27, 1954. Pulich found young just out of the nest near Boulder City on July 7, 1952.

Tachycineta thalassina. Violet-green Swallow. Spring and fall migrant on the desert. The earliest spring arrival record is for March 4 (1952, Overton), with birds remaining as late as June 21 (1951, Red Rock area). Fall movement has been noted as early as August 6 (1954, Pahrump and Las Vegas valleys), and as late as September 29 (1951, Las Vegas Valley) and October 2 (1951, Mohave Valley).

Iridoprocne bicolor. Tree Swallow. Our spring records are not as early as those given by Linsdale (1936:81), our earliest being March 3 (1954, Davis Dam area); records extend until as late as May 19 (1951, Pahrump Valley). Southward migration was noted as early as July 19 (1951, Mohave Valley), and it extends as late as September 2 (1953, Gold Butte area).

Riparia riparia. Bank Swallow. Two records: both from Pahranagat Valley, May 24, 1951 (one bird) and August 7, 1953 (one bird).

Stelgidopteryx ruficollis. Rough-winged Swallow. One nesting record: Meadow Valley, May 26, 1951, and another, possibly, in Pahranagat Valley, May 24, 1951. A flock of five birds flying northward was seen in Las Vegas Valley on June 28, 1951.

Hirundo rustica. Barn Swallow. An uncommon spring and fall migrant, between April 12 (1953, Overton) and June 4 (1951, Boulder City), and from August 8 (1953, Meadow Valley) to as late as October 3 (1951, Las Vegas Valley). Fisher (1893:110) records an earlier spring record from Ash Meadows on March 19, 1891.

Petrochelidon pyrrhonota. Cliff Swallow. Uncommon migrant, in the spring from May 3 (1953, Willow Beach, Lake Mohave) to June 28 (1951, Las Vegas Valley); and in the fall, from August 5 (1952, Boulder City) and August 6 (1953 and 1954, Pahrump Valley) to as late as September 5 (1951, Overton area). Van Rossem (1936:33) records a later date, September 13, 1930, at Indian Springs.

Progne subis. Purple Martin. Four records: one bird in Mohave Valley on May 14, 1951; 14 birds in Muddy Valley (1700 feet elevation, Clark County) on August 28, 1951; a "flock" of birds near Carp (2600 feet elevation, Meadow Valley Wash, Lincoln County) on August 29, 1951; and three birds in Pahrump Valley on August 5, 1954. These appear to be the first records for this species in Nevada since 1868 (cf. Linsdale, 1936:83).

Aphelocoma coerulescens. Scrub Jay. Fairly common permanent resident in most of the desert ranges, being particularly common in the oak chaparral (*Quercus– Garrya*) habitat. Occurrence of this species in the mesquite bosques of the lower valleys seems to be uncommon, but we have three records of such wanderings: Las Vegas Valley, March 17, 1951; and south of Overton, June 13 and August 11, 1953. On occasions this species also occurs in the Joshua tree environment, as in the Searchlight area on August 17, 1951; and even in the lower desert shrub (*Larrea-Dalea-Franseria-Krameria*) type, as in the Valley of Fire, September 13, 1957. Occasionally this jay takes advantage of the oasis at Boulder City, having been noted there on September 15 and October 3, 5, and 11, 1950, and on January 31 and April 9, 1951.

Corvus corax. Common Raven. Uncommon but widely distributed permanent resident on the desert. Ravens are seen most frequently as scavengers along the major highways across the desert. Road-killed rodents and reptiles furnish an ample food supply, and the density of Ravens in the vicinity of these highways is normally much higher than in more remote areas.

Corvus brachyrhynchos. Common Crow. A common winter visitor in at least the Moapa and Virgin valleys, arriving as early as October 10 (1951) and remaining as late as February 28 (1952). One summer record, from Pahrump Valley, August 25, 1951. Fisher (1893:71) records crows in Pahrump Valley as late as March, 1891.

Gymnorhinus cyanocephala. Piñon Jay. Widely scattered spring, summer, and fall residents, but of erratic occurrence. Records of flocks extend from as early as March 30 (1953, Virgin Mountains) to as late as September 27 (1951, Flat Nose Ranch). The absence of this species from desert areas in late fall and during the winter is not understood. Cottam (1936:123) noted this species 8 miles east of Alamo on March 5, 1925. Although these jays are normally associated with piñon pines, they are not uncommon in Joshua tree and oak chaparral areas on the desert, and they were seen in the desert shrub (*Yucca-Dalea-Acacia-Larrea-Coleogyne*) near Nelson on May 3, 1951.

Nucifraga columbiana. Clark Nutcracker. Although a common resident in the Charleston Mountains (cf. van Rossem, 1936:35), this species seldom occurs on the deserts. However, in 1951, a small group of nutcrackers spent most of July in Boulder City and were noted there as late as August 23.

During their stay in this area maximum daily temperatures reached 109°F. and averaged about 89°F. This invasion of a desert habitat in Nevada by this species more or less coincided with a widespread invasion of lowland areas to the west in California during the fall and winter of 1950–51 (Davis and Williams, 1957:297).

Parus gambeli. Mountain Chickadee. Recorded twice from the piñon-juniper covered McCullough Range (at about 5500 feet elevation), about 16 miles northwest of Searchlight, on August 21, 1951, and March 29, 1952. This species is of common occurrence in the Charleston Mountains and Sheep Range (van Rossem, 1936:35–36), but it has not been previously recorded in southern Nevada away from that area.

Parus inornatus. Plain Titmouse. Recorded on four occasions from the higher (4200 to 4500 feet elevation) piñon-juniper covered parts of the Gold Butte area, on October 14, 1951, June 19 and August 31, 1953, and September 26, 1954.

Auriparus flaviceps. Verdin. Although reported to be restricted to the Colorado and Virgin valleys by Linsdale (1951:239), this species is as widely distributed as the honey mesquite (*Prosopis juliflora*) in southern Nevada. Johnson and Richardson (1952:358) first record this bird away from the Colorado drainage, finding it in the Pahrump Valley and Ash Meadows in June, 1951. We have additional records for Pahrump Valley on May 19, 1951, and August 6, 1953 and 1954, and for Stewart Valley (2400 feet elevation, Nye County) on May 20, 1951. On the upland desert areas the catclaw (*Acacia greggii*) suffices as habitat for Verdins, and in this environment they have been observed in the McCullough Range on April 16, 1951; Eldorado Mountains near Nelson on May 3, 1951; Searchlight area on February 6, 1953, and August 5, 1954; Muddy Mountains on February 11 and 28, 1954; and on numerous occasions in the Gold Butte area. Fledglings were noted in Las Vegas Valley on May 24, 1952.

Psaltriparus minimus. Common Bushtit. Uncommon resident in brushy areas on the desert ranges. Recorded during most months of the year from the Mormon, Clover and Virgin mountains, the Tule Desert, and the Gold Butte area, these being all of the ranges on the eastern edge of Nevada's southern desert. Also noted on June 28, 1952, at Potosi Spring (5700 feet elevation), on the north slopes of Potosi Mountain.

Sitta canadensis. Red-breasted Nuthatch. Two records away from Boulder City (where there are numerous fall records): one bird in a catclaw thicket near Catclaw Spring, in the Gold Butte area, on September 28, 1954; and a small flock near Indian Spring, in the Virgin Mountains, on November 27, 1953.

Sitta pygmaea. Pygmy Nuthatch. One record away from the Charleston Mountains and the Sheep Range (where they are common—see van Rossem, 1936:38): several birds in the piñon pines near Big Pine Spring, McCullough Range, on March 29, 1952.

Campylorhynchus brunneicapillus. Cactus Wren. A fairly common permanent resident, normally found in the Joshua tree forests on the desert ranges, but also regularly recorded from the mesquite bosques in Las Vegas Valley. Frequent records have been obtained in the Castle (Clark County), Virgin, and Mormon mountains, and in the Gold Butte area. The northernmost record is from the Lincoln County country adjacent to Utah, southeast of Lime Mountain on the Tule Desert (4000 feet elevation), 24 miles east-northeast of Carp, on June 27, 1954.

Catherpes mexicanus. Canyon Wren. Uncommon permanent resident, recorded from the cliffs of Black Canyon above Lake Mohave on January 7, 1952, and in the higher elevations from March through November. Recorded from the Dead, Eldorado, Virgin, and Mormon mountains and from the Gold Butte area.

Salpinctes obsoletus. Rock Wren. Common fall, winter and spring visitor, but seldom recorded on the desert in the summer, from about the middle of June (June 21, 1952, near Nelson) to late July or early August (July 27, 1952, Las Vegas Wash and August 4, 1954, Dead Mountains). This species is known to occur on the higher desert ranges (Charleston Mountains and Sheep Range) in the summer (van Rossem, 1936:40).

Mimus polyglottos. Mockingbird. At least sometimes a winter resident in the Mohave Valley, having been noted there on January 25 and 31, 1952. Mockingbirds move into the higher and more northerly areas in late March (March 31, 1952, Blue Diamond, 3200 feet elevation, Clark County) and remain at least to mid-August (August 21, 1951, McCullough Range). A pair with fledglings recently out of the nest was seen at 4000 feet elevation in the Mormon Mountains on August 10,

1954. The parent birds were having some difficulties preventing a Loggerhead Shrike (*Lanius ludovicianus*) from preying upon their fledglings.

Toxostoma bendirei. Bendire Thrasher. Two records: on June 26, 1954, an adult made was collected by Gullion from an open stand of Mohave yucca (*Yucca schidigera*) on the south edge of the Tule Desert (3000 feet elevation), 10 miles east-southeast of Carp (no. 132624, Mus. Vert. Zool.). On July 1, 1954, at least five more birds of this species were seen in the dense Joshua tree forest between the south end of the Multichrome Range and the McCullough Range, 11 miles northwest of Searchlight. These constitute the second and third records of this species in Nevada. It was recorded previously from the Delamar area (5000 feet elevation, Lincoln County) by Jewett (1940*a*).

Toxostoma curvirostre. Curve-billed Thrasher. One record: in the course of a five and one-half hour count at a quail waterhole at Maynard Spring (2200 feet elevation), Gold Butte area, on August 10, 1953, a single individual of this species was seen foraging among the litter under large catclaws for more than an hour, often coming to within 20 feet of the truck in which Gullion was sitting. This species has not been reported from Nevada previously.

Toxostoma lecontei. Le Conte Thrasher. Not common but recorded from the Eldorado Mountains south to the California state line, Bird Springs area (4300 feet elevation, Clark County), Ash Meadows, Mormon Mountains, Tule Desert, and Kane Springs Wash. The Kane Springs Wash record, for August 7, 1954, apparently is the most northerly record for this species in Nevada. Records extend from February 6 (1953, Searchlight) to as late as August 27 (1952, Eldorado Mountains near Nelson). This thrasher is most commonly seen in areas of Mohave yucca and Joshua trees, but on July 1, 1954, one bird was seen in the creosote-bush—bur-sage type of desert at the south end of Eldorado Valley. Phillips reported encountering an adult with six young south of Searchlight on August 16, 1952. A bird collected by Gullion, at 2800 feet elevation, 8 miles southeast of Searchlight, on June 4, 1952, has been identified at the Museum of Vertebrate Zoology as *T. l. lecontei* (no. 126600, Mus. Vert. Zool.).

Toxostoma dorsale. Crissal Thrasher. These birds are normally closely restricted to the mesquite thickets in the Las Vegas, Pahrump, and Moapa valleys, being common year-round residents in these areas. However, they occasionally are seen in situations outside of this habitat. Notable records were obtained in the Gold Butte area on March 25 and 31, and September 2, 1953, and from September 20 to October 1, 1954; in the Dead Mountains on May 23, 1953; and at Highland Spring in the Multichrome Range, July 1, 1954. Banding records of these thrashers in the Las Vegas Valley suggest that these birds ranged over only a few hundred feet of mesquite bosque during a year's time.

Oreoscoptes montanus. Sage Thrasher. Spring and fall migrant on the desert, becoming common about February 10 (1954, Virgin Mountains) and having been noted as late as June 25 (1953, Mormon Mountains). Most of the birds, however, have passed to the north by mid-April. Southward migration in the fall has been noted between August 10 (1954, Pahranagat Valley) and September 29 (1954, Gold Butte area). This species may summer as far south as the Panaca area, Meadow Valley, and van Rossem (1936:40) found the species nesting in the Charleston Mountains. Linsdale's (1936:95) winter records for January 31 to February 5, 1934, in Mohave Valley, may represent stragglers or early spring migrants. Mrs. Poyser reported seeing two at Boulder Beach on January 1, 1951.

Turdus migratorius. Robin. Most common on the desert as a winter visitor from mid-October to early April, having been noted in the Gold Butte area from October 13 (1951) to April 6 (1953). Mrs. Poyser reported Robins nesting in Boulder City during 1953 and 1954 (Monson, 1953*b*:321; 1954:324).

Hylocichla guttata. Hermit Thrush. Uncommon spring and fall migrant on the desert. Spring dates extend from February 11 to May 31 (both 1951, at Boulder City), and fall dates extend from October 5 (1950, Boulder City) to November 30 (1951, Mohave Valley). The latter bird was collected and identified as *H. g. nanus* by A. R. Phillips.

Hylocichla ustulata. Swainson Thrush. One record: a bird trapped and banded near Turkey Spring (3000 feet elevation), in the Gold Butte area, September 27, 1954. This appears to be the first record for this species in southern Nevada.

Sialia mexicana. Western Bluebird. Six records: small flocks in mesquite thickets (feeding on fruit of mistletoe, *Phoradendron californicum*) in Las Vegas Valley on January 12 and 21, 1952, and March 15, 1953; and in Mohave Valley, January 25 and 31, 1952. One summer record from Hidden Forest (8000 feet elevation), Sheep Range, Clark County, June 27, 1951.

Sialia currucoides. Mountain Bluebird. Sparingly recorded from low desert ranges in winter, from as early as September 2 (1951, Virgin Mountains) to April 26 (1951, Mormon Mountains). Recorded at one time or another in winter from all of the desert valleys and ranges in southern Nevada.

Myadestes townsendi. Townsend Solitaire. A widespread and fairly frequent winter visitor to the desert, having been recorded as early as September 10 (1951) at Boulder Beach by Mrs. Poyser to as late as June 5 (1955) at Boulder City, also by Mrs. Poyser (Monson, 1955:395). Two summer records: Hidden Forest, Sheep Range, June 27, 1951, and reported by Mrs. Poyser at Lake Mead, August 16 and 23, 1952 (Monson, 1953*a*:30).

Polioptila caerulea. Blue-gray Gnatcatcher. Permanent resident on the intermediate (3500 to 5000 feet elevation) desert ranges, being most frequently found in close proximity to springs and waterholes. This species normally occurs in willow and cottonwood thickets in oak chaparral and piñon-juniper areas.

Polioptila melanura. Black-tailed Gnatcatcher. Recorded from Las Vegas Valley throughout the year, spreading to brushy washes in the lower desert ranges in April and remaining as late as August. This species is normally closely restricted to mesquite and catclaw thickets below an elevation of about 3000 feet.

Regulus satrapa. Golden-crowned Kinglet. Two additional records for the Charleston Mountains. Imhof reported birds from Lee Canyon (7500 to 9000 feet elevation) on October 6, 1951, and Pulich recorded this species in the same area on November 17, 1951. These records supplement those reported earlier by Pulich and Phillips (1951).

Regulus calendula. Ruby-crowned Kinglet. Uncommon winter visitor in brushy areas, arriving on the desert as early as September 26 (1954, Gold Butte area) and remaining as late as April 28 (1951, Las Vegas Wash).

Anthus spinoletta. Water Pipit. Recorded in desert areas from as early as October 8 (1951) by Imhof at Camp Three (4200 feet elevation, 39 miles east-southeast of Beatty, Nye County) to as late as March 31 (1951) in the Pahranagat Valley.

Bombycilla cedrorum. Cedar Waxwing. Erratic visitors to the desert. Recorded in three localities where mistletoe berries were available in mesquite thickets: in May, 1951—Pahrump Valley on the 19th, Ash Meadows on the 20th, and Pahranagat Valley on the 23rd. Also noted in Boulder City on October 10 and 20, and November 5 and 16, 1950, June 2 and October 28, 1951; and in mesquite thickets in Las Vegas Valley on January 11, 1952.

Lanius ludovicianus. Loggerhead Shrike. A common permanent resident on all parts of the desert. This is one of the several species which summers on the desert independently of free water supplies. Together with the Ash-throated Flycatcher and Black-throated Sparrow, it is one of the most widely distributed of the desert birds.

Vireo bellii. Bell Vireo. Recorded from the Dead Mountains and the Mohave Valley from March 17 (1952) to as late as August 16 (1951). A record of one bird from Las Vegas Valley, June 2, 1952.

Vireo vicinior. Gray Vireo. Recorded from the desert ranges in summer, from as early as April 28 (1953, Boulder City) to as late as September 3 (1951, Gold Butte area). This species has been noted in the Dead, Mormon, and Clover mountains, on the Tule Desert, and in Las Vegas Valley.

Vireo solitarius. Solitary Vireo. Four records: Potosi Mountain, May 18, 1951 (one bird), and June 28, 1952 (two birds); and Las Vegas Valley, one bird on May 22 and 23, 1952.

Vireo gilvus. Warbling Vireo. Spring and fall migrants on the desert, with spring records extending from April 25 (1952, Las Vegas Valley) to May 20 (1951, Pahrump Valley); fall records from August 14 (1952, Mohave Valley) to October 6 (1951, Boulder Beach). One summer record from the desert, July 27, 1952, at Boulder City.

Vermivora celata. Orange-crowned Warbler. Winter visitor, with spring dates as late as May 24 (1951, Pahranagat Valley). Fall migrants arrive as early as August 6 (1952, Boulder City). One summer record from Las Vegas Valley, July 3, 1951 (one bird).

Vermivora ruficapilla. Nashville Warbler. One record: one bird in migration, Gourd Spring, Mormon Mountains, September 1, 1951. This is the second record for this species in southern Nevada. It was reported previously from Mohave Valley on May 7, 1934, by Linsdale (1936:106).

Dendroica petechia. Yellow Warbler. Spring and fall migrant: recorded in spring between May 7 (1951, Dead Mountains) and June 2 (1952, Las Vegas Valley), and in the fall from August 5 (1951, Boulder Beach) to September 19 (1938, Boulder City—Grater, 1939*b*:221). Recorded from the Charles-

ton Mountains as early as April 30 (1931) by van Rossem (1936:47). Phillips identified a bird of the race *D. p. morcomi* taken by Pulich in Mohave Valley on May 3, 1951 (see Linsdale, 1951:242).

Dendroica nigrescens. Black-throated Gray Warbler. Spring and fall migrant on the desert. Spring migrants arrive as early as April 28 (1951, Las Vegas Wash), while fall migrants linger as late as November 30 (1951) in Mohave Valley. Three summer records: one bird, Potosi Mountain, June 28, 1952; three birds, Mormon Mountains, June 28, 1954; and one bird, Boulder City, July 31, 1952. National Park Service personnel reported to Pulich the occurrence of this species in Boulder City on January 14, 1952.

Dendroica townsendi. Townsend Warbler. Three spring records: one bird, Eldorado Mountains, east of Nelson, May 5, 1951; and one bird, Dead Mountains, May 7, 1951, and May 23, 1953. One fall record: one bird, Charleston Mountains, October 22, 1949. These spring records are the first for this species in the lower desert areas in Nevada.

Oporornis tolmiei. MacGillivray Warbler. Widely scattered in the shrubby washes on the desert during spring and fall migration. Spring records are between May 18 (1951, Potosi Mountain) and May 23 (1952, Las Vegas Valley) and fall dates range from August 18 (1951, Eldorado Mountains) to October 12 (1951, Gold Butte area).

Icteria virens. Yellow-breasted Chat. Widespread spring migrant with earliest arrival date of May 3 (1951, Mohave Valley). Three summer records from hot, mesquite bosques; heard in Moapa Valley, June 28, 1952; heard in Mohave Valley, July 19, 1951, and one bird seen there on August 4, 1954. The maximum recorded temperatures in these areas on these dates were 94°F. on June 28, 1952, 110°F. on July 19, 1951, and 102°F. on August 4, 1954. Our latest fall record is for September 17 (1952, Boulder City).

Wilsonia pusilla. Wilson Warbler. Spring and fall migrant. Spring dates range from May 7 (1951, Dead Mountains) to May 31 (1951, Boulder City); fall dates extend from August 13 (1950, Boulder City) to September 5 (1951, Muddy Mountains). Fisher (1893) records an occurrence, April 30, 1891, in the Charleston Mountains. A. R. Phillips identified a specimen taken by Pulich on May 14, 1951, in Mohave Valley, as belonging to the race *W. p. chryseola*.

Passer domesticus. House Sparrow. Common about towns, ranches, and scattered sparingly over the desert areas. One record far removed from human habitation: two females in Willow Wash (3100 feet elevation), Gold Butte area, April 2, 1953, at least 22 miles from nearest known populations of House Sparrows.

Sturnella neglecta. Western Meadowlark. Noted as a common permanent resident in the valleys and sagebrush areas by Linsdale (1936:112), but also found to be common throughout the year on the desert areas, particularly in desert grassland and creosote-bush—bur-sage habitats. Noted in these typical desert habitats in the Kane Springs Wash, Gold Butte, Searchlight and Indian Springs areas, Dead, Mormon and Eldorado mountains, and the Tule Desert.

Xanthocephalus xanthocephalus. Yellow-headed Blackbird. Recorded from the desert valleys from April 26 (1951, Moapa Valley) to as late as August 31 (1951, Meadow Valley). One late fall record: "several" birds, Las Vegas Valley, November 10, 1953. One record outside of the desert valleys: Imhof reported a single male at Camp Three on September 28, 1951.

Icterus cucullatus. Hooded Oriole. One additional record: three birds seen in the cottonwoods at Hyco Spring, east slope of the Dead Mountains, on May 23, 1953.

Icterus parisorum. Scott Oriole. Common summer resident in Joshua tree forests and Mohave yucca areas on the desert ranges from about April 26 (1951, Mormon Mountains) to as late as August 24 (1951, Mule Springs).

Icterus bullockii. Bullock Oriole. Present in the desert valleys and in the cottonwoods about springs in the desert ranges from as early as April 16 (1951, McCullough Range) to as late as September 7 (1951, when a bird was banded at Boulder Beach).

Euphagus cyanocephalus. Brewer Blackbird. Permanent resident in valley areas, occasionally wandering on to the deserts. Recorded at Mountain Springs, May 18, 1951; Gold Butte area, September 3 and October 12, 1951, and September 26, 1954; and Nelson Landing (600 feet elevation), Lake Mohave, February 7, 1951.

Molothrus ater. Brown-headed Cowbird. Scarce summer resident in desert valleys and ranges from about May 3 (1953, Willow Beach) to as late as September 8 (1951, when one was banded at

Boulder Beach). Pulich collected a bird at Potosi Spring on June 28, 1951, which was identified as *M. a. obscurus* by A. R. Phillips.

Piranga ludoviciana. Western Tanager. Summer visitant (nonbreeding) in desert valleys and in brushy washes on the deserts from about May 3 (1951, in the Mohave Valley, and 1952, in the Dead Mountains) to as late as September 8 (1951, Boulder City).

Piranga rubra. Summer Tanager. Summer resident in Mohave Valley from about May 2 (1952) to as late as October 2 (1951). One Nevada record away from the Mohave Valley area, when a single bird was seen at McCullough Spring, in the McCullough Range, on August 22, 1951.

Pheucticus melanocephalus. Black-headed Grosbeak. Spring and fall migrant, being recorded from April 29 (1951, Boulder Beach, by Mrs. Poyser) to June 5 (1951, Dead Mountains), and from August 4 (1954, Dead Mountains) to as late as September 1 (1951, Mormon Mountains). Pulich observed this species on Potosi Mountain on June 27 and 28, 1952, and van Rossem (1936:51) recorded birds as late as September 20, 1930, in the Sheep Range.

Guiraca caerulea. Blue Grosbeak. Eight summer records: one bird, Potosi Mountain, July 19, 1952; one bird, Meadow Valley Wash, one mile north of Carp, August 8, 1952; Mohave Valley, one bird on August 2 and two birds on August 14, 1952, and one bird on August 4, 1953; Pahrump Valley, August 5 and 6, 1953, and again in the same area on the same dates in 1954. Mrs. Poyser reported this species at Boulder Beach on May 21, 1951.

Passerina amoena. Lazuli Bunting. Uncommon spring and fall migrant, occurring from May 20 (1951, Ash Meadows) to as late as June 28 (1954, Mormon Mountains) in the spring and from August 22 (1951, McCullough Range) to September 17 (1951, Boulder Beach) in the fall. A late record reported to Pulich by Park Service personnel, October 29, 1951, at Boulder City. Pulich found a nest with four young about three days old in a low sagebrush (*Artemisia* sp.) at Potosi Spring on June 28, 1952.

Hesperiphona vespertina. Evening Grosbeak. Three additional records: remains of one bird found in a water tank at Cabin Spring (about 6000 feet elevation) in the Sheep Range, June 26, 1951; two birds, Boulder City, January 5, 1952; and Mrs. Poyser reported this species at Boulder Beach on February 8, 1951.

Spinus pinus. Pine Siskin. One additional record: 20 to 30 birds feeding on Gullion's lawn in Boulder City, May 22, 1951.

Spinus tristis. American Goldfinch. Two additional desert records: two birds at Granite Springs (1400 feet elevation), Dead Mountains, 12 miles southwest of Davis Dam, on March 12, 1951; and one bird at Knob Hill Spring (about 4000 feet elevation), 3 miles south of Nelson, May 6, 1951.

Spinus psaltria. Lesser Goldfinch. Winter and breeding resident, but with no midsummer records available. Dates of occurrence extend from August 14 (1951) to June 28 (1952, both at Boulder City). Pulich observed fledglings in Boulder City on May 20, 1952.

Loxia curvirostra. Red Crossbill. Three winter records: three birds on December 24 and 25, 1950, and a flock on January 15, 1951, all at Boulder City. This species has been previously reported from southern Nevada by Grater (Linsdale, 1951:245) on November 14, 1938.

Chlorura chlorura. Green-tailed Towhee. Uncommon spring and fall migrant, occurring on the desert from as early as April 1 (1953, when a bird was banded in the Gold Butte area) to as late as June 19 (1953, Gold Butte area) in the spring and from September 1 (1951, Mormon Mountains) to as late as November 27 (1952, when a bird was banded in Las Vegas Valley) in the fall.

Pipilo erythrophthalmus. Rufous-sided Towhee. Recorded as a spring and fall migrant through desert areas, from March 5 (1952, Gold Butte area) to April 24 (1951, Mormon Mountains) and from September 26 (1954, Gold Butte area) to November 27 (1953, Virgin Mountains). This species was recorded on Potosi Mountain on July 19, 1952, and in the Mohave Valley on January 31, 1952. A bird collected by Gullion in Willow Basin (3950 feet elevation), Gold Butte area, on April 4, 1953, has been identified at the Museum of Vertebrate Zoology as *P. e. montanus* (no. 130599, Mus. Vert. Zool.).

Pipilo aberti. Abert Towhee. One record well north of usual distribution: a bird seen near Vigo (2500 feet elevation, 5 miles southwest of Carp), Meadow Valley Wash, August 29, 1951. Also, one bird was seen in the desert shrub (3750 feet elevation) 3 miles northwest of Nelson, on May 3, 1951, far removed from its normal mesquite bosque habitat in the desert valleys.

Calamospiza melanocorys. Lark Bunting. Of erratic occurrence in winter and spring. From about May 2 to 14, 1952, flocks were recorded on the desert from the Searchlight area, Las Vegas Valley,

Coyote Wells (2300 feet elevation, Lincoln County), Pahranagat Valley, Delamar Flats (5000 feet elevation, Lincoln County), and Meadow Valley. Gullion collected an adult male at 3000 feet elevation, 16 miles north of Searchlight, on May 3, 1952 (no. 125717, Mus. Vert. Zool.). This species has been previously recorded on Nevada's southern deserts in April, 1891, by Fisher (1893:108), in February, 1940, by Jewett (1940*b*:307), and in December, 1948, by Pulich (Monson, 1949:181).

Passerculus sandwichensis. Savannah Sparrow. Six records scattered through the year as follows: "several" birds, Pahrump Valley, August 25, 1951; one bird, Boulder Beach, March 1, 1952; Camp Three, September 28 and October 3 and 9, 1951, reported by Imhof; and one bird collected in Las Vegas Wash on April 5, 1952, by Pulich (identified as *P. s. nevadensis* by A. R. Phillips).

Pooecetes gramineus. Vesper Sparrow. Uncommon spring and fall migrant. In spring noted from April 12 (1951, Mohave Valley and the Virgin Mountains) to as late as May 24 (1951, Meadow Valley); in the fall, from August 25 (1951, Pahrump Valley) to as late as October 11 (1951, Gold Butte area). Fisher (1893:85) recorded this species as early as March 10 (1891) in Ash Meadows and Las Vegas Valley.

Chondestes grammacus. Lark Sparrow. Spring and fall migrant, being noted from about April 30 (1951, Las Vegas Valley) to May 24 (1951, Pahranagat and Meadow valleys) in the spring and from August 8 (1953, Meadow Valley) to about September 10 (1951, Boulder Beach) in the fall.

Amphispiza bilineata. Black-throated Sparrow. Common spring, summer, and fall resident, being absent from Nevada's deserts for not over two months in midwinter, if that long. The earliest spring record is for February 6 (1953, Searchlight area) and our latest fall record is for November 28 (1953, Gold Butte area). However, Grater (Linsdale, 1951:245) reports this species in the Lake Mead area in December. In this area, this species is one of the ubiquitous birds of the creosote-bush and desert shrub environments, being distributed generally independently of available drinking water. Not commonly noted in valley areas, but abundantly recorded from all upland desert areas. Pulich found a nest containing three eggs in a sagebrush near Potosi Spring on June 28, 1952.

Amphispiza belli. Sage Sparrow. Winter visitant on the desert, being recorded from as early in the fall as August 5 (1954, Pahrump Valley) and remaining in the spring as late as June 28 (1954, Mormon Mountains). However, this species was recorded from the Indian Springs area northwest of Las Vegas by van Rossem (1936:56–57) in July, so perhaps it is best considered a permanent resident, at least on the higher desert areas. A bird collected along the Davis Dam Highway (Dead Mountains) by Pulich on November 30, 1951, was identified as *A. b. nevadensis* by A. R. Phillips. Like the Black-throated Sparrow, this species is most frequently seen in the upland desert shrub, but one bird was trapped in a mesquite bosque in Las Vegas Valley on January 17, 1953.

Junco hyemalis. Slate-colored Junco. Three records: one bird, Boulder City, March 24, 1952; one bird, Potosi Spring, March 31, 1952; and one bird at Indian Spring, Virgin Mountains, November 27, 1953.

Junco caniceps. Gray-headed Junco. Two birds at Mule Springs, August 24, 1951; numerous birds in the Clover Mountains, at the head of Pennsylvania Wash (6500 feet elevation, 8 miles northeast of Elgin), August 31, 1951. Recorded several times in winter: Willow Basin, Gold Butte area, April 1, 1953; Township Canyon (5000 feet elevation), in the Virgin Mountains, 9 miles south of Bunkerville, November 13, 1953; and the Charleston Mountains, October 6, and Johnnies Water, November 28, both records by Imhof in 1951.

Spizella arborea. Tree Sparrow. One additional record: "a number" of birds in the Eldorado Mountains, 5 miles northwest of Nelson (3000 feet elevation), on March 13, 1951 (see also, Pulich and Gullion, 1953).

Spizella passerina. Chipping Sparrow. Recorded in the spring from April 25 (1951, Mormon Mountains) to May 19 (1951, Pahrump Valley) and in the fall from August 22 (1951, McCullough Range) to November 3 (1951, Las Vegas Wash). One winter record: one bird, Boulder City, January 13, 1952.

Spizella breweri. Brewer Sparrow. Regular and common spring and fall migrant. This species is abundant on the desert in spring from about March 24 (1952, Boulder City) to May 26 (1951, Meadow Valley) and in the fall from about the end of August to mid-October. Mrs. Poyser reported this species at Boulder Beach on February 27, 1951, and Pulich saw fledglings (and collected one) just out of the nest at Potosi Spring on June 28, 1952.

Zonotrichia leucophrys. White-crowned Sparrow. Common winter visitor in the lower valleys

from as early as September 17 (1951, Boulder Beach) to as late as April 25 (1952, Las Vegas Valley). On the desert ranges early fall appearance was recorded on September 29 (1954, Gold Butte area) and a late spring date of May 3 (1951) was recorded in the Eldorado Mountains. These sparrows linger as late as May 24 (1951) in Meadow Valley.

Zonotrichia atricapilla. Golden-crowned Sparrow. A single bird was taken from a quail trap in Willow Basin (3550 feet elevation), Gold Butte area, 26 miles southeast of Overton, on March 31, 1953 (no. 130600, Mus. Vert. Zool.). This is the first record for this species in southern Nevada and apparently the fourth record for the state (Linsdale, 1951:246).

Zonotrichia albicollis. White-throated Sparrow. Rare fall migrant. One additional record: a single bird seen scratching among the litter under a shrub live-oak (*Quercus turbinella*) in Township Canyon, Virgin Mountains, on November 13, 1953 (see also, Gullion, 1953).

Passerella iliaca. Fox Sparrow. One additional record: one bird seen in the willows at Upper Pierson Spring (4400 feet elevation) in the Gold Butte area, September 29, 1954. Grater (1939*b*:221) has an earlier record from southern Nevada, "below Boulder Dam," on August 29, 1938; another record was obtained in Boulder City on October 29, 1952, by W. and J. Bromley (Monson, 1953*a*:31).

Melospiza melodia. Song Sparrow. A permanent resident, recorded from the Mohave and Las Vegas valleys, the Flat Nose Ranch east of Pioche, and Roger's Spring (1500 feet elevation) in the Muddy Mountains south of Overton, all within the range given by Linsdale (1951:246, 247). Also noted in Pahrump Valley on May 19 and 20, 1951, a locality from which this species has not been previously recorded.

DISCUSSION

Most of the birds occurring on the desert areas are restricted to the vicinity of moist valleys or permanent springs or stock-water developments. However, there are a few species whose distribution on the desert seems to be independent of the distribution of drinking water. These are also the species which, if they are seen near waterholes or springs, seem to be there because water attracts their preferred food in greater abundance. These species, when near water, were seldom if ever seen to drink during the course of more than 80 morning quail counts (each five and one-half hours long) at waterholes during midsummer from 1951 to 1954. Included in this list is the Ash-throated Flycatcher, Horned Lark, Cactus Wren, Le Conte Thrasher, Loggerhead Shrike, Scott Oriole, and Black-throated Sparrow.

Some other species which are commonly seen in the type of vegetation produced by surface or underground water (primarily mesquite bosques), but which were not seen to take advantage of available water include the Verdin, Crissal Thrasher, Blue-gray Gnatcatcher, and Phainopepla.

Among the interesting aspects of the occurrence of birds on southern Nevada's deserts are the sporadic invasions of this area by species not normally expected to occur. In this respect the winter of 1950–51 was a particularly rich season on the desert, with several boreal species appearing. Notable among these were the Downy Woodpecker, Clark Nutcracker (in the summer of 1951), Cedar Waxwing, Pine Siskin, and Red Crossbill. The occurrence of these species in this winter is surprising in some respects, for it was an unusually mild winter farther north. The Weather Bureau (1952:144), summarizing Nevada's weather for 1951, says, "The winter season ended as one of the warmest on record with 78% of normal precipitation and just 60% of the usual snowfall." Southern Nevada's deserts were in the grip of a prolonged, severe drought when these boreal visitors arrived.

Other species of sporadic occurrence include the Purple Martin during the summer of 1951, Bendire Thrasher in June, 1954, and the Lark Bunting in May, 1952.

One may wonder just how rare or uncommon some of these desert species really are in an area such as southern Nevada. Prior to our field work many of the areas reported upon in this paper apparently had not been visited by persons interested in the fauna.

Neither Linsdale (1936:14–22) nor Hall (1946:5, 652–669) indicates that the McCullough and Multichrome ranges, the Castle, Eldorado, Virgin and Clover mountains, the Tule Desert or the Kane Springs Wash area had been visited by earlier zoologists, and these same authors show but one or two previous visits by zoologists to the Mormon Mountains (Juniper Mountains of Linsdale, 1936) and the Gold Butte area, and these were probably of short duration.

The foregoing collection of records emphasizes the need for more extensive and prolonged studies of the birdlife on Nevada's desert areas, and particularly the need for widespread and continual collecting. Some areas appear to be especially promising for extensive studies due to their unusual vegetation types. One of these is the McCullough Range northwest of Searchlight which reaches 6996 feet elevation, and which appears to have avifaunal aspects of the Spring Mountain Range, as reported upon by van Rossem (1936) and Miller (1945).

Another area of particular interest is the Dead Mountains south of Searchlight which reach over 5000 feet elevation. These mountains contain an interesting mixture of plants representing elements of the western xeric evergreen forest, the Arizona succulent desert, and the California microphyll desert, as described by Kearney and Peebles (1951:13–15). Here species such as ocotillo (*Fouquieria splendens*), bear-grass (*Nolina bigelovii*), smoke tree (*Dalea spinosa*), and desert lavender (*Hyptis emoryi*) make their only appearance in Nevada. In addition there is an interesting piñon-juniper forest at higher elevations, which includes thickets of hollyleaf cherry (*Prunus ilicifolia*), a shrub of the California Coast Range (McMinn, 1939:196).

A third area needing thorough investigation is the Virgin Mountains south of Bunkerville and Mesquite. This range, which reaches 8064 feet elevation, has much of the vegetation of the western xeric evergreen forest and the Arizona chaparral (Kearney and Peebles, 1951:13–14) of northern Arizona, including at least one clump of Arizona cypress (*Cupressus glabra*). Douglas fir (*Pseudotsuga menziesii*) is reported to occur on the upper parts of this desert range.

The fourth area of particular interest is the Clover Mountains, reaching 7750 feet elevation, which lie south and east of Caliente. These mountains contain extensive forests of yellow pine (*Pinus ponderosa*), as well as extensive thickets of manzanita (*Arctostaphylos pungens*) and Gambel oak (*Quercus gambelii*), these representing a westward extension of the northern mesic evergreen forest (Kearney and Peebles, 1951:13) occurring in the mountains of southwestern Utah and northern Arizona.

It should be apparent that many details concerning southern Nevada's avifauna still remain unknown. However, the present list, supplementing the papers of Linsdale and others, should help to crystallize knowledge of the birdlife of this region and should form a basis for more thoroughgoing investigations in the future.

LITERATURE CITED

American Ornithologists' Union
1957. Check-list of North American birds. Fifth ed. (published by the Union, Baltimore, Md.).

Baldwin, G. C.
1944. Uncommon birds of the Boulder Dam area, Nevada. Condor, 46:35.

Christensen, G. C.
1954. The Chukar partridge in Nevada. Nev. Fish and Game Comm., Biol. Bull., 1:1–77.

Cottam, C.
1936. Notes on the birds of Nevada. Condor, 38:122, 123.

Davis, J., and Williams, L.
1957. Irruptions of the Clark nutcracker in California. Condor, 59:297–307.

Fisher, A. K.
1893. Report on the ornithology of the Death Valley Expedition of 1891, comprising notes on the birds observed in southern California, southern Nevada, and parts of Arizona and Utah. N. Amer. Fauna, 7.
Grater, R. K.
1939*a*. New bird records for Nevada. Condor, 41:30.
1939*b*. New bird records for Clark County, Nevada. Condor, 41:220, 221.
Gullion, G. W.
1953. Additional bird records from southern Nevada. Condor, 55:160.
1956. Let's go desert quail hunting. Nev. Fish and Game Comm., Biol. Bull., 2:1–76.
Gullion, G. W., and Christensen, G. C.
1957. A review of the distribution of gallinaceous game birds in Nevada. Condor, 59:128–138.
Hall, E. R.
1946. Mammals of Nevada (Univ. Calif. Press, Berkeley).
Jewett, S. G.
1940*a*. Bendire thrasher in Lincoln County, Nevada. Condor, 42:126.
1940*b*. The lark bunting in southern Nevada. Condor, 42:307.
Johnson, N. F.
1956. Recent bird records for Nevada. Condor, 58:449–452.
Johnson, N. F., and Richardson, F.
1952. Supplementary bird records for Nevada. Condor, 54:358, 359.
Kearney, T. H., and Peebles, R. H.
1951. Arizona flora (Univ. Calif. Press, Berkeley).
Linsdale, J. M.
1936. The birds of Nevada. Pac. Coast Avif. No. 23:1–145.
1951. A list of the birds of Nevada. Condor, 53:228–249.
McMinn, H. E.
1939. An illustrated manual of California shrubs (Stacey, San Francisco).
Miller, A. H.
1945. Birds of the yellow pine association of Potosi Mountain, southern Nevada. Condor, 47: 130, 131.
Monson, G.
1949. Winter season. December 1, 1948, to March 31, 1949. Southwest region. Audubon Field Notes, 3:180–181.
1953*a*. Fall migration. August 16 to November 30, 1952. Southwest region. Audubon Field Notes, 7:29–31.
1953*b*. Nesting season. June 1 to August 15, 1953. Southwest region. Audubon Field Notes, 7:320–322.
1954. Spring season. April 1 to May 31, 1954. Southwest region. Audubon Field Notes, 8:323, 324.
1955. Nesting season. June 1 to August 15, 1955. Southwest region. Audubon Field Notes, 9: 393–395.
Pulich, W. M.
1952. The Arizona crested flycatcher in Nevada. Condor, 54:169, 170.
Pulich, W. M., and Gullion, G. W.
1953. Black-and-white warbler, dickcissel, and tree sparrow in Nevada. Condor, 55:215.
Pulich, W. M., and Phillips, A. R.
1951. Autumn bird notes from the Charleston Mountains, Nevada. Condor, 53:205, 206.
van Rossem, A. J.
1936. Birds of the Charleston Mountains, Nevada. Pac. Coast Avif. No. 24:1–65.
Weather Bureau
1952. Annual summary 1951. U. S. Dept. Commerce, Climatological Data—Nevada, 66:144–149.

Cloquet, Minnesota, Irving, Texas, and Sacramento, California, December 22, 1958.

FROM FIELD AND STUDY

Fishing Rates in the Black Skimmer.—Davis (Condor, 53, 1951:259) has published interesting data on the "fishing efficiency" of the Black Skimmer (*Rynchops nigra*). This relates to the amount of skimming time necessary to catch a fish. He observed that the rate of catch varies greatly, but he gave only his maximum figure. At the north cayo of Laguna Atascosa in Cameron County, Texas, he found that the Black Skimmers caught one fish per bird per 6.2 minutes of skimming time. While studying the feeding methods of the Black Skimmer in the same area, I obtained further data which demonstrate the variability of rates of catch. "Skimming time," recorded with a stop watch while I observed a bird through binoculars, represents time during which a flying bird had its lower mandible immersed. My field work was made possible through the cooperation of Luther Goldman, manager of the Laguna Atascosa National Wildlife Refuge, and by financial aid from the Mae P. Smith Research Fund of the American Museum of Natural History.

On the south cayo of Laguna Atascosa, where the water was very shallow and muddy, the birds fed either along the edges or tacked back and forth along the body of water. Here, on the morning of July 1, 1956, they caught one small fish per bird per 1.6 minutes of skimming time in the course of 19.2 minutes of skimming. The effective catch (fish swallowed) was close to the same figure because only one of the twelve fish caught during this time was dropped. At mid-afternoon of the same day the rate of catch was one small fish per bird per 4 minutes, based on observations over 28.5 minutes of skimming. None of the fish caught was dropped. Observations were made later along a wider part of the south cayo where the water was a maximum of three inches deep. On the afternoon of July 28, 1956, in 6.9 minutes of skimming, the birds caught fish at a rate of one per bird every 46 seconds (0.8 min.). One of the fish caught was dropped. On the following day the rate of catch averaged one fish per bird per 55 seconds (0.9 min.) in 13.8 minutes of skimming. However, four of the fifteen fish caught were dropped and three were lost to Laughing Gulls, reducing the effective rate of catch to about one-half the original rate.

The third area under observation was a deep rectangular pond, also on the Laguna Atascosa National Wildlife Refuge. Early in the morning, myriads of small fish appeared at the surface around the edges of the pond and formed a dense border two to three feet wide. The fish dispersed soon after sunrise and did not concentrate again in this manner until the following morning. Skimmers fed at this pond throughout the night, but they were especially active and numerous in the early morning, skimming only along the pond borders where the fish had concentrated. Between 6:30 and 7:00 a.m. the rate of catch averaged one fish per bird every 3 seconds (0.05 min.) in the course of 6 minutes of skimming! Of the 115 fish caught about 15 were dropped, producing an effective catch of one fish per bird per 3.6 seconds.

Davis (*ibid.*) stated that the efficiency of the Black Skimmer was comparable to that of diving birds such as the Least Tern (*Sterna albifrons*) and that it was much less than that of the Reddish Egret (*Dichromanassa rufescens*) and of the White Pelican (*Pelecanus erythrorhynchos*). Such comparisons are of doubtful validity, partly because the birds are not necessarily utilizing the same food niche and partly because it is more difficult to define the active feeding period of a heron or pelican than to define that of a skimmer.—Richard L. Zusi, *Department of Zoology, University of Maine, Orono, Maine, February 27, 1959.*

Distributional Records of the Common Goldeneye and the Crissal Thrasher in Southeastern California.—On December 6, 1958, C. Jackson Selsor and the writers observed 11 Common Goldeneyes (*Bucephala clangula*) resting in a group on a small fresh-water reservoir in the heart of Brawley, Imperial County, California. The only previous record for Imperial County that we could find is that of Clary and Clary (Condor, 37, 1935:80) for the Salton Sea. According to Grinnell and Miller (Pac. Coast Avif. No. 27, 1944:85) the habitat of this species is "Typically, salt-water bays and estuaries; prefers open, quiet water of lesser depth."

Although the Crissal Thrasher (*Toxostoma dorsale*) occurs regularly in the low desert regions of southeastern California, it has not been recorded previously from eastern San Diego County. On December 12, 1958, C. Jackson Selsor and the authors observed four of these thrashers on the out-

skirts of Borrego township, well within San Diego County limits. All four were seen at midday, and two of them were viewed from a distance of approximately twenty-five feet. The species has been previously reported from Borrego Valley, as well as at nearby Yaqui Well, by reliable observers, but these sightings have gone unrecorded.—KEN STOTT, JR., and JAMES R. SAMS, *Natural History Museum, Balboa Park, San Diego, California, January 19, 1959.*

Procellaria aequinoctialis on Amazon River in Brazil.—According to Murphy (Oceanic Birds of South America, 2, 1936:641–642), the breeding ground of the Shoemaker (*Procellaria aequinoctialis*) is the sub-Antarctic and low Antarctic islands, the Falklands, South Georgia, Crozet, Kerguelen and a number of the sub-Antarctic outliers of New Zealand. Northward it occurs to about 30° south latitude in the open oceans and to ten or fifteen degrees farther on the eastern side of South America; casually it ranges to the neighborhood of Cape Frio, Brazil. Pinto (Cat. Aves Brasil, vol. 1, 1938:19) mentions the coast of São Paulo (Iguape) and Bahia.

The ornithological collection of the Museu Goeldi possesses two skins of the Shoemaker. One female was collected by E. Snethlage in the Marajó Islands on August 25, 1921, and one male was collected at Cametá, Rio Tocantins, State of Pará, on September 5, 1937 (no collector's name on the label). These two unexpected records extend the range of this species farther north in the Atlantic Ocean than formerly known.

Those who have travelled the Amazon River by boat to the mouth of the Rio Tocantins know how wide it is and that seldom can one see both banks of the river at the same time. During the rainy season water spouts are common, and in the dry season the northwest winds blow frequently. Small and medium-sized boats cross the mouth of the Rio Tocantins carefully. The natives call the place baia (bay). To me this region looks like a sea. This explains why this oceanic bird could be collected at a locality like Cametá, 250 kilometers from the coast. Another possible explanation is that it was carried to this locality by a hurricane.—FERNANDO C. NOVAES, *Museu Goeldi, Belem, Pará, Brazil, January 15, 1959.*

The Starling in Eastern México.—While Blake (Birds of Mexico, 1953) does not list the Starling (*Sturnus vulgaris*) for México, other authorities (Mexican Check-list, 1957:219) report it variously for northern Tamaulipas or for northeastern México "since 1939." A review in Bird-Banding, 18, 1947:184, of Helmuth Otto Wagner's "*Sturnus vulgaris* L. als Wintergast in Mexico," Ornithologische Monatsberichte, 49, 1941:143–144, gives these records. "April, 1935 (circumstances not clear); December 1938, 2 at Anaxhuac, 50 kilometers east of Nuevo Laredo; 24 December 1939, ten at Santa Lucia, between Laredo and Monterrey." A more recently published record is found in the Newsletter of the Texas Ornithological Society, December 9, 1953:7. L. Irby Davis and party made an intensive bird count on January 1 and 2, 1953, at Tampico. The compiler, Edgar Kincaid, states, "Starling, 27 (some of these were in the state of Veracruz—apparently a new state record . . .)."

On the return from a vacation trip, on December 1, 1946, Mrs. Coffey and I, with the B. F. McCameys, saw a flock of 500 Starlings south of and within sight of Nuevo Laredo. On December 12, 1948, we saw five in Linares, Nuevo León. In 1956 we looked for the species especially around Tampico and Veracruz, without success. On December 3, 1956, while looking over blackbirds on a pasture in the outskirts of Coatzocoalcos, Veracruz, Mrs. Coffey spotted 15 Starlings. This was much farther south than we had expected to find the species.—BEN B. COFFEY, JR., *Memphis, Tennessee, January 15, 1959.*

Red-necked Grebe in San Diego County, California.—On December 21, 1958, Red-necked Grebes (*Podiceps grisegena*) were observed twice on Glorietta Bay, an inlet on the Coronado shore of San Diego Bay, by James R. Sams of the San Diego Natural History Museum, C. Jackson Selsor, Jordan S. Roux, William McTear, and the writer. At 8 a.m. two specimens were seen swimming together among a mixed concentration of Horned Grebes (*Podiceps auritus*), Eared Grebes (*Podiceps caspicus*), Pied-billed Grebes (*Podilymbus podiceps*), and various species of wintering ducks. At 4 p.m. on the same day, four Red-necked Grebes in a compact group were observed in the same locality.

Grinnell and Miller (Pac. Coast Avif. No. 27, 1944:37) give the southernmost known station of the species as Elsinore Lake, Riverside County. However, our observation in addition to previous

verbal but unrecorded reports of this grebe at various points on San Diego Bay (Shelter Island and Coronado) in recent years would indicate that the winter range of the species reaches the southern border of California.—KEN STOTT, JR., *Natural History Museum, Balboa Park, San Diego, California, December 22, 1958.*

A New Race of the Mexican Pootoo from Western México.—The Mexican Pootoo (*Nyctibius griseus*) occurs from México to South America and the Caribbean region. It is a rare species in México, where it occurs mainly in the eastern section of the country (Mexican Check-list, pt. 1, Pac. Coast Avif. No. 29, 1950:151); the eastern population is referable to the race *mexicanus*. In addition, three specimens have been collected on the west coast of México; two of these are in the Moore Collection at Occidental College. Through the courtesy of Dr. Raymond M. Selle, Director of the Moore Laboratory of Zoology, I was able to examine the specimens of *Nyctibius griseus* therein. It is evident that the two specimens from western México pertain to an undescribed race, which may be known as:

Nyctibius griseus lambi, new subspecies

Type.—Male, no. 36607, collection of Robert T. Moore, Occidental College, taken at Lajuela, 75 feet, Colima, México, April 11, 1943, by Chester C. Lamb; orig. no. 7899 (duplicates a previous original number of the same collector).

Diagnosis.—Similar to *N. g. mexicanus* of eastern México, but wing and tail longer, bill longer and, especially, wider (see table of measurements; reference point for bill measurements is anterior edge of nostril).

Range.—The west coast of México, from Mazatlán, Sinaloa, south at least to Lajuela, Colima.

In addition to the type, a second specimen of *lambi* was available, a male collected by Mr. Lamb at Sauta, 7 miles south of Santiago Ixquintla, 150 feet, Nayarit, on April 15, 1946. Four male and three female *mexicanus* from eastern México were available for comparison. In color, *lambi* is slightly paler dorsally than *mexicanus*, but there is overlap in this character, and a specimen from Presidio, Veracruz, is indistinguishable from *lambi* in this regard.

Measurements in Millimeters of Males of *Nyctibius griseus* from México

Moore Coll. No.	State	Date	Wing	Tail	Bill length	Bill width
		lambi				
36607	Colima	Apr. 11	321	231	13.8	3.2
41878	Nayarit	Apr. 15	315	222	12.9	3.1
Average			318	226.5	13.35	3.15
		mexicanus				
32263	San Luis Potosí	Mar. 17	305	215	11.7	2.7
36182	Veracruz	Mar. 25	308	205	11.7	2.7
59175	Veracruz	Apr. 11	292	205	13.4	2.5
Average			301.7	208.3	12.27	2.63

Ridgway (Bull. U. S. Nat. Mus., 50, pt. 6, 1914:590, footnote *c*) noted the occurrence of cinnamon and gray color phases in *N. g. jamaicensis*, and these same color phases also occur in *lambi* and *mexicanus*. The type of *lambi* is in the cinnamon phase, as are three female *mexicanus*. Ridgway (*loc. cit.*) suggested the possibility that the cinnamon phase occurs more frequently in females of *jamaicensis* than in males. The same possibility is suggested for Mexican specimens by the present material. Regardless of race, only one of six males is in the cinnamon phase whereas all three females are in this phase.

A male collected at Rancho Caracol, 30 miles south of Tezonapa, Veracruz, on August 20, 1943 (RTM 48637) is a first-year bird that has completed the postjuvenal molt. However, two of the basal under tail coverts are nearly pure white and are very loose in texture, and they have obviously been retained from the juvenal plumage. The measurements of this specimen, not included in the table, are: wing, 302 mm.; tail, 213; bill length, 11.1; and bill width, 2.5.

In addition to the specimens from Nayarit and Colima, a specimen in the British Museum (Natural History) was collected by Forrer at Mazatlán, Sinaloa (Hartert, Cat. Birds Brit. Mus., 16, 1892:626; Salvin and Godman, Biologia Centrali-Americana, Aves, 2, 1888–1897:399), and presumably it pertains to the race *lambi*.

It is a pleasure to name this new subspecies after Chester C. Lamb.—John Davis, *University of California, Hastings Reservation, Carmel Valley, California, March 5, 1959.*

An Unusual Concentration of White-tailed Kites in Napa County, California.—The White-tailed Kite (*Elanus leucurus*) has generally been considered a rather scarce bird in California since about the turn of the century. In later years substantial numbers have been reported in San Diego County (Dixon, Dixon, and Dixon, Condor, 59, 1957:156–165). It appears, therefore, worthwhile to record a large concentration observed on November 27, 1958, in northern California. On this date at 7:30 a.m. while duck hunting in the marshes of the lower Napa River, Napa County, I observed what was apparently a roosting aggregation of 45 kites. There was an exceptionally dense ground fog that morning and the kites, which were perched on a line of eight dead eucalyptus trees, very likely had held to their roosts considerably later than they would have normally done. This line of trees extends for approximately 300 yards at right angles to the levee on the southwestern side of Knight Island, which at that point is bordered by China Slough. Knight Island had been flooded for a salt pond several years previously and the bases of the trees had therefore been completely submerged, causing them to die and lose all of their leaves. In this state they provided a very safe, if rather exposed roosting site and it is probable that most, if not all, of the kites occupying this marshland area were concentrated there.—William M. Longhurst, *University of California, Hopland Field Station, Hopland, California, December 31, 1958.*

Migration of Starlings into the Coastal Region of Northwestern California.—Glover (Condor, 55, 1953:219) reported the first records of Starlings (*Sturnus vulgaris*) for Humboldt County in northwestern California: remains of a male and a female starling were found on April 18, 1952, on the Timmons Ranch about four miles northwest of Arcata. On December 1, 1952, one was found dead in the Arcata Bottoms two miles west of Arcata.

The writer, who moved to Arcata in August of 1953, on October 28 saw 25 starlings mingled with a flock of Brewer Blackbirds (*Euphagus cyanocephalus*) at the south end of Humboldt Bay, Humboldt County. No other starlings were observed in this area until the following spring when five were seen along the Mad River on March 5 and six in the Arcata Bottoms on March 25, 1954. Several were seen in the Arcata Bottoms between December 12 and April 19.

In 1955 between October 21 and December 22 the following records of starlings were made by the writer: one, near south end of Humboldt Bay, October 21; 30 near mouth of Mad River, October 30; one in Sunny Brae one mile southeast of Arcata, November 9; 8 near Eel River, November 12; 4 near Bayside, November 25; 1000 plus in a field near Sunny Brae, December 4; 200 in Arcata Bottoms, December 22.

The first starlings seen in northern Humboldt County in the vicinity of Prairie Creek State Park were reported by Kenneth Legg: 50, at the Park on November 17, 1955; 25 were seen in the same area on December 11, 1956.

The last starling record in the spring of 1956 consisted of a flock of 35 seen on February 10 flying south along the north part of Humboldt Bay by the writer.

The largest invasion of starlings into this region occurred in the fall and winter of 1956–57. The first seen were 200 at Cock Robin Island on the lower Eel River on November 11 by the writer. Other records are: 3, flats west of Loleta, November 24; 23, Arcata Bottoms near Mad River, December 2; 1000 plus, lower Eel River, December 9; 25 at Prairie Creek State Park, December 11 (Kenneth Legg); 200 plus, south of Fields Landing, December 15.

On December 22, 1956, a spectacular flight of starlings was seen by the writer and George Black near the Eel River in the vicinity of Dungan's Pool west of Loleta. At 4:40 p.m. to the southeast of us, flying low over the Eel River and going north, was a large flock of starlings estimated to be over 4000 individuals. We were close and had glasses; all birds in the flock appeared to be starlings. Within

five minutes another large flock of 2000± birds flew directly over us headed in the same general direction. These were followed at 4:46 p.m. by two more large flocks. From 4:45 to 5:00 p.m. we noted two flocks of over 500 birds in each flock and several smaller flocks moving over the river following the birds that had passed previously. We estimated that at least 10,000 starlings were seen by us.

Small flocks were seen in the vicinity of Arcata in the months of January and February of 1957. Two thousand were seen in one flock between Arcata and Eureka on February 7. February 23, 1957, is the last date that starlings were noted in this area that spring.

Otis Wright collected a starling in Del Norte County in December of 1954. Dr. R. F. Dasmann observed the following: 50 near Crescent City, Del Norte County, January 21; several near Lake Earl, Del Norte County, January 21, 1957.

We have several records for the winter of 1957–58 but at no time were as many birds seen as during the previous winter. There are thus far no summer records of starlings for this area.

Apparently, starlings arrived in eastern Washington, eastern central Oregon, and northeastern California about the same time (see, for example, Quaintance, Condor, 48, 1946:95).

Apparently, the starling is just beginning to breed in the state of California. Mr. William Anderson observed a singing pair of starlings in the city of Alturas in northeastern California in the month of June, 1958. The pair were observed several times in the vicinity of a nesting cavity in a large tree. He believes that these birds were nesting but neither eggs nor young were seen.—CHARLES F. YOCOM, *Division of Natural Resources, Humboldt State College, Arcata, California, November 15, 1958.*

Notes on Occurrences of Birds in San Diego County, California.—Information, not previously reported, on two species of birds in San Diego County, California, is as follows: For the past two years, Ground Doves (*Columbigallina passerina*) have been observed near San Ysidro, California, by Mr. John W. Bishop. This year I located some nests in the area and kept records on them. The first nest was found on May 25. During the season seven nests (containing eggs and/or young) were found. Two of these nests were used for two broods. Two other nests had evidence of use, although I never actually saw eggs or young in them. The five active nests produced a total of seven birds. If it is presumed that the other two nests produced one young each, the season's total of young was nine. Nesting was carried on into October. On October 2, two nests were found with young or eggs in them. On October 11, one nest had two nearly-fledged young in it. This appears to be the first nesting record for this species in San Diego County, but breeding has occurred in coastal southern California as early as 1952 (Comby, 56, 1954:104–105).

A Palm Warbler (*Dendroica palmarum*) was sighted in the southwestern corner of Balboa Park, San Diego, on October 31, 1958. It was recognized by its jerking tail, its ground activity (feeding near a pile of dried grass and eucalyptus leaves), and markings. The last Palm Warbler collected in California was a female taken on February 2, 1953, in Berkeley (Johnson, Condor, 55, 1953:276). The last sight record for this species is that of one seen at Point Reyes, California, on October 9, 1955 (Fisher, Condor, 58, 1956:166).—ARTHUR MORLEY, *San Diego, California, December 22, 1958.*

Recent Occurrences of Oldsquaw in Southern California.—As stated by Grinnell and Miller (Pac. Coast Avif. No. 27, 1944:86), the Oldsquaw (*Clangula hyemalis*) is "rare" and "irregular" in California. Appearances in the southern portion of the state through the years have been sporadic. Because of the relative rarity of this species in southern California, it might be well to summarize its most recent occurrences there. In the period from Cogswell's observation of a single bird at Alamitos Bay, Los Angeles County, on February 11, 1939 (Grinnell and Miller, *loc. cit.*) to that of a single female at Desert Beach, north end of the Salton Sea, Riverside County, on February 22, 1948 (Audubon Field Notes, 2, 1948:149), there were no published records. Wartime conditions from 1941 to 1945 no doubt limited coastal observations during part of this nine-year period. As regional editor for the Southern Pacific Coast Region of Audubon Field Notes, I have had the opportunity to record occurrences of this species in this region since December of 1948. In perusing my notes (those marked AS are personal observations), I find the following well-authenticated records (in addition there is the record of a dead bird found at La Jolla, January 25, 1959, as reported by Morley and Sams, Condor, 60, 1958:337): 1, December 29, 1948, at Huntington Beach, Orange County (Audubon Field

Notes, 3, 1949:149); 1 male, December 28, 1949, at Morro Bay, San Luis Obispo County (*ibid.*, 1950: 173); 1 male taken by a hunter, November 16, 1950, near the south end of the Salton Sea, Imperial County (*ibid.*, 1951:227); 1, late December, 1950, at Santa Monica, Los Angeles County (*ibid.*, 1951: 227); 1 female, December 26, 1953, at San Diego Bay, San Diego County (*ibid.*, 1954:223); 1, February 7, 1954, at Goleta Slough, Santa Barbara County (*ibid.*, 1954:271); 2 females (AS), December 29, 1955, to January 22, 1956, at Alamitos Bay, Los Angeles County, and 1 female there (AS) until at least January 28, 1956 (*ibid.*, 10, 1956:282); 1 male (AS), December 29, 1955, and present for several weeks thereafter at Seal Beach, Orange County (*ibid.*, 1956:282); 1 male, November 24, 1956, at Alamitos Bay, Los Angeles County (*ibid.*, 1957:60) until at least December 31, 1956 (AS); 14, January 26, 1958, 6 miles west of Santa Catalina Island, Los Angeles County (*ibid.*, 1958:306); and 1 male, March 13 to at least March 29, 1958, at Oceano, Santa Barbara County (*ibid.*, 1958:306). The thirteen observations during the 10-year interval of 1948 to 1958 compared with but three observations of this species from November 11, 1938 (Sefton, Condor, 41, 1939:83) to February 22, 1948, probably reflects increased field activity of observers, and this species must still be considered rare and irregular in southern California.—ARNOLD SMALL, *Los Angeles, California, January 13, 1959.*

Pine Grosbeak and Lawrence Goldfinch in Nevada.—Recent field work by the authors has resulted in the collection of two species unrecorded by Linsdale (Condor, 53, 1951:228–249) or by subsequent compilers dealing with the distribution of birds in Nevada.

Pinicola enucleator. Pine Grosbeak. At 7800 feet elevation on the West Fork of Gray Creek, one mile west and one and three-fourths miles north of Rose Nob in the Carson Range of Washoe County, three individuals of this species were seen in a mature subalpine forest of white pines and red firs on July 10, 1958. The grosbeaks were apparently attracted to a commotion started by other birds as a result of imitated Pygmy Owl calls. The birds warbled repeatedly from perches in the uppermost boughs of the firs, but remained together and gave no indication of being established on territories. Two grayish individuals were present in addition to the single red male obtained (Mus. Vert. Zool. no. 136969). This bird had left testis measurements of 12 × 9 mm. It is typical of the race *californica* which occurs in the main Sierra Nevada to the west and south of the Gray Creek locality. The occurrence of this species in the Carson Range was not wholly expected, regardless of the close proximity of this mountain mass to the Sierra Nevada proper. The break in the hygrogradient at the Sierra Nevada crest is considerable, with the east slope receiving much less precipitation than the west slope and consequently supporting a less luxuriant boreal forest. The forest at the Gray Creek locality is not typical of most subalpine areas in the Carson Range, which are rather arid and cut-over, in that it is as yet unlogged and thus consists of fair-sized trees in moderately close stands. It is of interest to note that two species of subalpine forest birds, the Black-backed Woodpecker (*Picoides arcticus*) and the Evening Grosbeak (*Hesperiphona vespertina*), listed by Linsdale (*op. cit.*) from the Carson Range, are accorded resident status on doubtful evidence. A third species, the Hammond Flycatcher (*Empidonax hammondii*), is listed as a possible resident in the Carson Range but it has not yet been found there in summer. Although small numbers of these species and of the Pine Grosbeak undoubtedly do breed in the Carson Range, it is believed that their occurrence there is marginal.

Spinus lawrencei. Lawrence Goldfinch. Linsdale (Pac. Coast Avif. No. 23, 1936:134) placed this bird on his hypothetical list on the basis of the report of Cooper (Ornith. Calif., 1, 1870:171), who found it during the winter at Fort Mojave, Arizona, a locality on the Colorado River across from southern Nevada. This goldfinch can now be included in the Nevada avifauna as a result of a minor extension of known wintering range. On April 4, 1958, a singing male (left testis 5 × 4 mm.) was taken on the Colorado River flood plain in a thicket of small Fremont cottonwoods, tamarisks, and arrowweed one-half mile west and one-half mile south of the Snyder Ranch, 500 feet elevation, in extreme southern Clark County. The bird (Mus. Vert. Zool. no. 136691) weighed 9.2 grams and showed no fat. One-half hour later a second bird was heard singing in dense arrowweed and tamarisk growth near the site of the first collection, but it could not be located. It is notable that Grinnell (Univ. Calif. Publ. Zool., 12, 1914:166) encountered the species only at Riverside Mountain during his extensive field work in the Colorado Valley in the winter and spring of 1910.—NED K. JOHNSON and RICHARD C. BANKS, *Museum of Vertebrate Zoology, Berkeley, California, April 21, 1959.*

NOTES AND NEWS

Cost of publishing the extensive paper on Pectoral Sandpipers in the current issue was met in part by special subsidy.

Subjects and speakers at recent divisional meetings of the Cooper Ornithological Society have included the following: "Behavior of the Western Gull," a motion picture by R. A. Boolootian, presented by Thomas R. Howell, at Los Angeles, February 26, 1959; "Water and Salt Requirements of Birds," by George A. Bartholomew, at Los Angeles, April 28, 1959; "Experiences with Subtropical Birds in Colombia, South America," by Alden H. Miller, at Berkeley, March 5, 1959.

Papers on the scientific program of the thirtieth annual meeting of the Cooper Ornithological Society in Berkeley on April 3 and 4, 1959, were: "Food Habits of the Northern Shrike on the Arctic Slope of Alaska," by Tom J. Cade; "Preview of a New Concept in Natural History Guides," by Arthur C. Smith; "A Barn Swallow Study at Prairie Creek State Park," by Ken Legg; "Some Aspects of Social Organization in the Carolina Chickadee," by Keith L. Dixon; "The Birds of Glen Canyon, Utah," by William H. Behle; "Orientation of Migratory Restlessness in the White-crowned Sparrow," by L. Richard Mewaldt; "Standard Metabolic Rate as a Function of Body Weight in Birds," by James R. King; "Experiments on Torpidity in the Poor-will," by Thomas R. Howell and George A. Bartholomew; "Report on the Meeting of the International Committee for Bird Preservation at Helsinki, Finland," by Junea W. Kelly; "Behavior of the Andean Sparrow (*Zonotrichia capensis*)," by Alden H. Miller; "Present Status of the Avifauna of the Hawaiian Islands; An Appraisal," by Richard E. Warner; "Molt in the Green Jay," by Frank A. Pitelka; "Molt and Age Determination in *Empidonax hammondii*," by Ned K. Johnson; "The Breeding Biology of *Empidonax* Flycatchers," by John Davis; "Does the Present Management of the Mourning Dove Endanger its Survival?" by Henry M. Weber; "Pairing and Hostile Behavior in a Covey of California Quail," by Ralph J. Raitt; "Observations on the Roosting Behavior of California Quail," by Ian I. McMillan; "A Shorebird Study on Humboldt Bay, California," by Richard T. Holmes; "Ant-Tanagers and Ant Swarms in British Honduras," by Edwin Willis; "Territory Size in the Bewick Wren in Relation to Chaparral Vegetation," by Howard L. Cogswell; "Life History of the White-winged Crossbill, *Loxia leucoptera*," by Wendell Taber; "Song Programing in Several Species of Birds," by William R. Fish; "Results of a Banding Study of Abert and Canyon Towhees in the Same Habitat," by Joe T. Marshall, Jr., "Social Organization in Red-winged and Tricolored Blackbirds," by Gordon H. Orians; "The Function of the Male Display of the House Finch, *Carpodacus mexicanus*," by William L. Thompson; "Evolution of Nest-building in African Weaverbirds (Ploceidae)," by Nicholas E. Collias and Elsie C. Collias. "Galápagos Revisited" was the subject of Robert I. Bowman's address and motion picture presented at the annual banquet.

Request for Information.—In some kinds of animals having two or more distinct color phases, non-random mating occurs. I should like to investigate the possibility that this sort of preferential mating occurs in certain species of North American birds with two color phases. The question can be best answered by an analysis of records of a large sample of breeding pairs. I should therefore be glad to receive any records of the color phases of breeding pairs of the following species: Screech Owl (*Otus asio*), red and gray forms; Ferruginous Hawk (*Buteo regalis*), dark and light forms; western Red-tailed Hawk (*Buteo jamaicensis calurus*), dark and light forms. Instances of birds of intermediate coloration would also be valuable. For the purposes of this inquiry, records of definitely mated pairs are needed, no matter whether the members of the pair are the same or of different coloration. Further details can be supplied to anyone interested in participating in this work. —D. F. Owen, *Department of Zoology, University of Michigan, Ann Arbor, Michigan.*

The Smithsonian Institution has accepted for publication as a Bulletin of the United States National Museum "Life Histories of North American Cardinals, Grosbeaks, Buntings, Finches, Towhees, and Allies, written by A. C. Bent and a large number of collaborating authors.—Wendell Taber.

For Sale, Exchange, and Want Column—Each member of the Cooper Society is entitled to one short advertising notice in any issue of the Condor free. Notices of over 3 lines will be charged for at the rate of 25 cents per line. Send advertising copy to Jack C. von Bloeker, Jr., Los Angeles City College, 855 N. Vermont Ave., Los Angeles 29, California.

WANTED—2 copies of "A Study of the Structure of Feathers, with Reference to Their Taxonomic Significance," by Asa C. Chandler, U. C. Publ. Zool., vol. 13, no. 11, pp. 243–446, with pls., Apr. 17, 1916. Quote price.—LYNDON L. HARGRAVE, *Box 1562, Globe, Arizona.*

FOR SALE OR EXCHANGE—Will sell, or exchange for bird skins: Brewer, N. Am. Oölogy; Raine, Bird Nesting in N. W. Canada; Davie, Methods in the Art of Taxidermy; Floral Park, N. Y., The Warbler; Forbush and May, Natural History of Birds of Eastern and Central N. Am.; Capen, Oölogy of New England; Hutson, The Ornithologist's Guide; Knowlton, Birds of the World; Burroughs, Fresh Fields; Ingersoll, Bird Nesting; Miner, Jack Miner and the Birds; Elliot, Fading Trails; Dorsey, Why We Behave Like Human Beings; Rourke, Audubon; Wallace, Lure of the Labrador Wild; Andrews, Ends of the Earth; Lowell Thomas, Land of the Black Pagoda; Pettingill, Lab. Manual of Ornithology; Peattie, Green Laurels; Dugmore, Bird Homes; Singer, Story of Living Things; Harrison, Am. Birds in Color; Goodspeed, Plant Hunters in the Andes; Cruikshank, Wings in the Wilderness; Bendire, Life Histories of N. Am. Birds, 2 vols.—G. WILLIAM RICHTER, D.O., *P. O. Box 365, Canfield, Ohio.*

FOR SALE—Complete run through vol. 9 (1950–1958) of Bulletin, Kansas Ornith. Soc., $3.30, or 10¢ per number—cash, check, or stamps.—RICHARD F. JOHNSTON, *Museum of Natural History, Univ. of Kansas, Lawrence, Kan.*

FOR SALE—Unbound Condors, 1933–1958, inclusive, but vol. 38, no. 6, vol. 39, no. 1, and vol. 59, no. 6, missing, and vol. 56, no. 5 in duplicate. Will accept best offer.—ARTHUR F. HALLORAN, *P. O. Box 448, Cache, Okla.*

WANTED—Bulletin, American Museum of Natural History, vol. 1, no. 7, 1886, or a reprint of Prof. J. A. Allen's article, "The Masked Bob-white of Arizona and Its Allies," which appears in the above-listed bulletin.—SEYMOUR H. LEVY, *Rt. 9, Box 960, Tucson, Arizona.*

PREPARATION OF MANUSCRIPTS FOR THE CONDOR

Articles published in the Condor normally are written by members of the Cooper Ornithological Society. Practically all the Society's money goes into the journal; neither the editor nor the business manager receives any pay other than the satisfaction of doing a service worthily. The preparation of good copy by the author will contribute greatly to accuracy of published output, dispatch in handling, and economy of production.

To be acceptable for inclusion in the Condor, articles should contain original material and indicate its significance. They must not duplicate in any substantial way material that is published elsewhere. Any type of subject bearing on birds may be considered; but the geographic areas of primary concern are western North America, Central America, and the Pacific Basin. Manuscripts may be sent to the editors at the Museum of Vertebrate Zoology. Proofs with edited manuscripts will be sent to authors, at which time reprints may be ordered.

In the interests of accuracy and economy, observe the following: do not duplicate data in text, tables, or charts; check citations to original sources and verify text references; quoted statements must be exact replicas of the original; use vernacular names applicable to the entire avian species (for a guide in this regard, consult the A.O.U. Check-list of North American Birds, Fifth Edition, 1957; insert scientific names for species but not the subspecific name except in taxonomic papers or where the race concerned has been critically determined by the author or his collaborators on the basis of specimens; revise the manuscript repeatedly to remove superfluous words and phrases, immaterial detail, and repetitious statements.

Note Condor style and usage. "General Articles" and the "Field and Study" items are set up in different form. Provide a concise, meaningful title, and, where needed, subtitles within the text. Footnotes are not used. The address line may serve to indicate institutional connection, and to it should be added the date of transmittal of the manuscript. Terminal bibliographies are usually desirable where five or more titles are to be cited; otherwise, the references may be included in the text. For bibliographic style, note closely the practices employed in recent volumes of the journal. A factual summary is recommended for longer papers.

Rules for copy.—(1) Typewrite material, using one side of paper only; (2) double space all material and leave liberal margins; (3) use 8½ × 11 inch paper of standard weight (avoid onion skin); (4) carbon copies are not acceptable; (5) place tables on separate pages and plan them to fit normal page width; (6) number pages in upper right hand corner.

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Helpful references on writing: Manual of Style, University of Chicago Press, and Rules of the Editorial Committee, University of California Press. On scientific nomenclature: Fifth Edition of the A.O.U. Check-list, The Distribution of the Birds of California (Pac. Coast Avif. No. 27), and The Distributional Check-list of the Birds of México, Parts I and II (Pac. Coast Avif. Nos. 29 and 33); authors are not required to follow the nomenclature of these works.